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DEAN OF THE FACULTY OF SCIENCE, IMPERIAL UNIVERSITY OF TOKYO.

Systematic and Anatomical Studies on Some Japanese Plants, II.

(JUNCACEAE)

By

Yosisuke SATAKE.

With 24 Textfigures and 4 Plates.

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Introduction.

The *Juncaceae* of Japan is rather a small family comprising as it does only two genera and 45 species and 19 varieties. Consequently some kinds of monographs or iconographs of this family may well have existed already. But there being in reality no such work to be found in Japan, we have so far only followed the opinions of foreign botanists in the case of Japanese rushes. This is mainly due to the fact that our botanists have refrained from studying the same groups (*Junci* and *Luzulae*), owing to the extreme difficulty in distinguishing specifically one plant from another by flowers and leaves which are rather similar in their taxonomic characters in nearly all the species. Through the suggestion of Professor B. HAYATA, I have undertaken to work up these difficult groups by studying all the species so far found in Japan, from the view-point of systematic anatomy, in the hope that some specific criteria might be found in the structure of peduncles, carpels and seeds. This work has been executed from the spring of 1930 up to the same season of 1933.

In the commencement of my work, I had at first the intention of studying just so much characteristics as are recognizable in the anatomy of peduncles and testae and tegmenta of seeds, but afterwards my attention was occasionally called to the fact that there exist some important criteria in the anatomy of carpels, and this I have pursued with utmost care in the present work.

Fresh material is in many cases wanted in the study of the anatomy of peduncles, but herbarium-specimens are mostly sufficient for carpels, and consequently the studies on carpels are to be considered as much more conveniently executable than those on the other parts of the plants. As there is as yet no such work regarding carpels on the rush-family, I may be allowed to say that at least the part in the present paper concerning carpels is the original production of my own.

In the fourth part of this paper I have enumerated all the species so far recorded from Japan, but I have not here proposed any new system. In the final part I have mentioned some of literature on the Japanese *Juncaceae*, regarding anatomy or relating to floras.

The main aim of this work is to give a concrete idea of what natural relation every species of Japanese rushes bears to each other in its internal and external characters. If the present paper may make even the least contribution to our knowledge of the classification of the Japanese *Juncaceae*, my labour will be amply repaid.

In conclusion, I avail myself of this opportunity of tendering my hearty thanks to Professor B. HAYATA for his painstaking revision of this manuscript. Nor should I forget to express my indebtedness to Professor K. SHIBATA and to Professor T. NAKAI for their kindness in giving me many facilities for my work. I am also very much indebted to Professor K. MIYABE and Professor G. KOIDZUMI who put their valuable specimens to my disposal. To other staffs of the Botanical Institute, who have helped me directly or indirectly, I am under great obligations.

June 8, 1933.

Botanical Institute, Faculty of Science,
Imperial University of Tokyo.

I. Systematic Anatomy of Peduncles.

On the anatomy of the stems, leaves and rhizomes of the *Juncaceae*, there are many studies made by BUCHENAU (5-6), BLAU (2), HASLINGER (10) and others. But these organs are to be easily affected by any ecological factor and therefore can not be regarded as affording systematic criteria; for example, the mechanical tissue in the stem is differently situated according to the different portions, and also according to whether the stem bears flowers or fruits in the same species or even in the same individual. I have consequently chosen, as the object of this study, peduncles which are probably not so changeable as the other organs like stems or rhizomes and which are rather simpler in their structure than those of the latter two, and I have studied what important rôle the anatomical characters of the peduncles play in the taxonomy of the Japanese *Juncaceae*. The term peduncle used here denotes that of a head in *Juncus* and *Luzula* excepting the subgenus *Pterodes*, but means that of a flower in the latter subgenus.

a. Technical Method.

Observations are made in the cross section of peduncles in fresh or dry materials. The sections are cut by hands, stained by safranin to examine

the lignified tissue, and are kept in 50% glycerin. The same method is taken in the case of carpels.

b. Structure of Peduncles and Analytical Key to the Species.

1. *Juncus*.

Peduncles of *Juncus* consist of five parts: epidermis, cortex, mechanical tissue, vascular bundle and pith. From the view-point of the systematic anatomy, the most valuable characters are found in epidermis, cortex and mechanical tissue.

The epidermis shows a most remarkable characteristic and is composed of variously shaped epidermal cells. Viewed in the cross section, the epidermal cells are usually lignified and thickened on the outer side and are sometimes covered with cuticle. The most typical form is rectangular with shorter radial side than the tangential side. This kind of the epidermal cells is found in *Juncus tenuis*, *J. decipiens* and *J. bufonius* (Fig. 2-3). In *Juncus Maximowiczii* (Fig. 4-7) they are somewhat quadrate and larger than those in any other species. In *Juncus alatus* (Fig. 1-3), *J. papillosus* and *J. oligocephalus* (Fig. 2-5, 6) they are oval and somewhat thickened on the outer side. The most interesting fact is found in *Juncus prominens* (Fig. 1-5; Fig. 3), in which the outer cell-walls of the epidermal cells are not only thickened, but also remarkably elevated on the outer side (Fig. 3-4). It should be noticed that this characteristic is never found in other species, except in *Juncus falcatus* and its allies.

Stomata in the epidermis afford also an important criterion in systematizing. They consist of two guard-cells and two subsidiary cells parallel to the former, as much the same manner as in the *Poaceae* or in the *Cyperaceae*. In cross section the guard-cells are found to

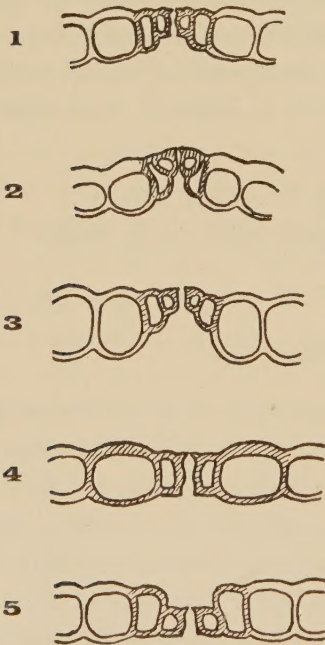


Fig. 1. Five different types of stomata in *Juncus*. 1. *J. prismatocarpus* var. *Leschenaultii* subvar. *pluritubulosus* BUCHEN. 2. *J. beringensis* BUCHEN. 3. *J. alatus* FRANCH. et SAVAT. 4. *J. castaneus* SMITH. 5. *J. prominens* MIYABE et KUDÔ. Those portions in the figures given with oblique lines are guard-cells and subsidiary cells.

be mostly rectangular or nearly quadrate, rarely triangular or elliptical, their two lateral cell-walls are thin and the outer and inner cell-walls are very thick. In some species the guard-cells have, seen in cross section, each two points on the face of the stomatic cleft which points are caused by cuticle-accumulation at the outer and inner sides, or only one point at the outer side. The guard-cells are usually as large as the subsidiary cells (Fig. 4.-2) or often smaller than the latter (Fig. 2.-5, 8).

The shape of the subsidiary cells and the relation of the latter to the guard-cells and the epidermal cells are very various in different species. Viewed in cross section of peduncles, the subsidiary cells are nearly rectangular in most species, but rarely triangular as in *Juncus beringensis* (Fig. 1.-2); their cell-walls are usually thinner than those of the guard-cells or epidermal cells, even on the outer side; their radial lengths are in most cases the same as or a little shorter than those of the epidermal cells and their tangential lengths are much shorter than those of the latter; the guard-cells are smaller than the subsidiary cells, as we see in *Juncus tenuis*, *J. bufonius* (Fig. 2.-2), *J. Fauriei* (Fig. 4.-2) and *J. kamschatcensis*; on the contrary, in *Juncus triglumis* (Fig. 2.-8) and *J. castaneus* (Fig. 1.-4; Fig. 4.-10) the subsidiary cells are longer in both radial and tangential lengths than the epidermal cells, and the guard-cells are as long as the epidermal cells in radial length, but one half as long as the latter in tangential length. In *Juncus oligocephalus* (Fig. 2.-5), *J. alatus* (Fig. 1.-3) and *J. papillosus*, the subsidiary cells are very small and one half as long as the epidermal cells in both radial and tangential lengths, and the guard-cells are still smaller and one half as long as the subsidiary cells in both radial and tangential lengths.

The guard-cells are nearly always situated at the upper part of the subsidiary cells, and the subsidiary cells are also located at the upper part of the epidermal cells. A few exceptional cases are met with in *Juncus prominens* and *J. subulatus* where the guard-cells are situated at the lower part of the subsidiary cells which are again located at the lower part of the epidermal cells (Fig. 1.-5; Fig. 3.-1, 2). This character is peculiar to these two species just mentioned,¹⁾ which are distinctly separated from other species.

Juncus prominens and *J. falcatus* have a prominence on the outside cell-walls of the epidermal cells and are therefore also obviously different from *Juncus subulatus* or other species. It is quite proper that *Juncus subulatus*

1) HASLINGER (10), p. 1169.

should represent the subgenus *Subulati*, and *Juncus prominens* and *J. falcatus* another subgenus *Graminifolii*. As far as my knowledge extends, the latter two species should collectively represent a new section in the subgenus *Graminifolii*, owing to their peculiar epidermis and stomata.

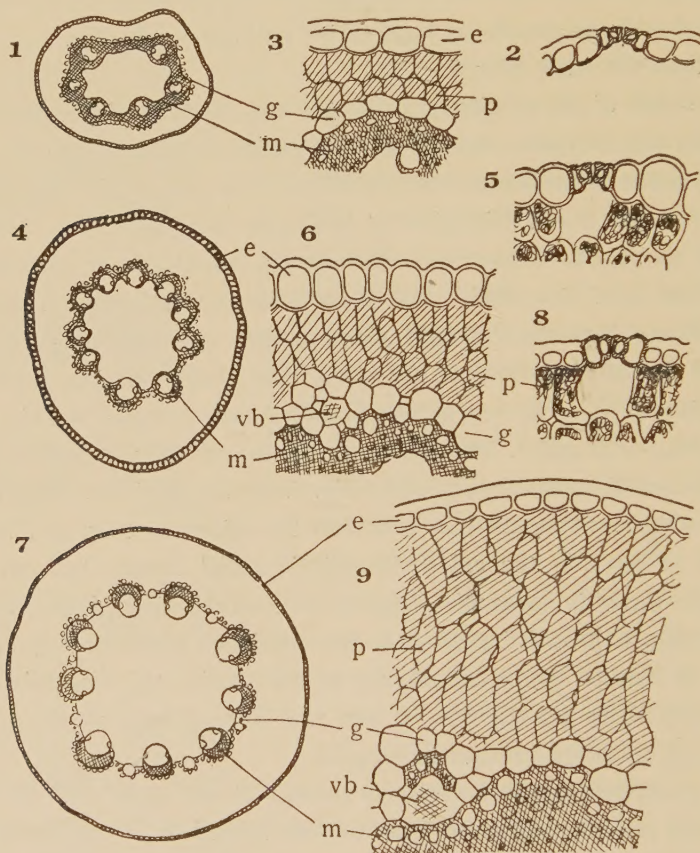


Fig. 2. Cross section of the various kinds of peduncles in *Juncus*. 1-3. *J. bufonius* LINN. 4-6. *J. oligocephalus* SATAKE et OHWL. 7-9. *J. triglumis* LINN. 2, 5, 8. stomata; 3, 6, 9. peripheral portions of the peduncles; e. epidermal cell; p. cortex; g. parenchyma-sheath; m. mechanical tissue; vb. vascular bundle. 1, 4, 7 = $\times 50$; 2, 3, 5, 6, 8, 9 = $\times 225$.

Cortex or assimilation-tissue consists of many polygonal, oblong, or elongated parenchymatous cells. Generally speaking, one or two layers of parenchymatous cells, lying close to the epidermis, form the palisade tissue, and the cells near the mechanical tissue are usually rounded; but in some cases as in

Juncus Fauriei (Fig. 4.-3), *J. setchuensis* var. *effusoides* and *J. curvatus* (Fig. 4.-5), the parenchymatous cells are all rounded or polygonal and by which cells the latter three are distinctly separated from the other species with the palisade tissue.

Mechanical tissue consists of strongly lignified and thickened sclerenchymatous cells, and is always found in the regions of conductive organs, but is never seen in other parts of peduncles, although we see the same tissue in the lower parts of the stem of the *Juncaceae* or in that of the *Poaceae* or in that of the *Cyperaceae*.

All the *Junci* may be classified into three groups according to the different relation of mechanical tissue, which the latter bears to the vascular bundles:

1) the first group including *Juncus triglumis* (Fig. 2.-7) and *J. Maximowiczii* (Fig. 4.-6) is distinguishable from the other groups in having the mechanical tissue only on the outer side of every vascular bundle; 2) the second group represented by a single species *Juncus beringensis* is separated from the others in having all the vascular bundles embedded entirely in the mechanical tissue; 3) the third group comprising a great many species of *Juncus* is characterized by the circular ring of the mechanical tissue connecting all the vascular bundles.

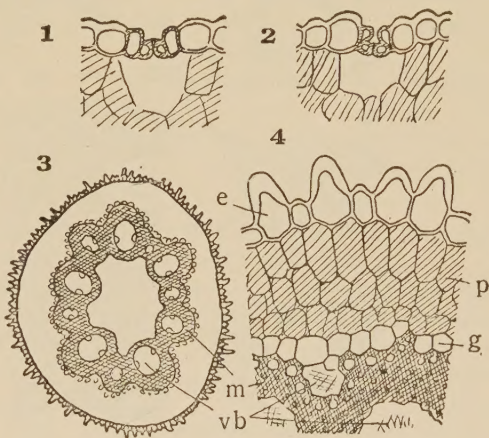


Fig. 3. Cross section of the peduncle of *Juncus prominens* MIYABE et KUDÔ. 1-2. stomata; 4. peripheral portion of the peduncle; e. epidermal cell with a prominence; p. cortex; g. parenchyma-sheath; m. mechanical tissue; vb. vascular bundle. 1, 2, 4 = $\times 225$; 3 = $\times 50$.

Juncus Mertensianus, *J. castaneus* (Fig. 4.-9) and *J. oligocephalus* (Fig. 2.-4) have the intermediate form as to the occurrence of the mechanical tissue between the second and the third groups.

Between the cortex and the mechanical tissue, there is always found a layer of cells which are considered to be probably originated from the mechanical tissue. The layer consists of lignified and thin-walled cells without contents. This may, I think, correspond to the parenchyma-sheath which is generally found in the leaves of the *Poaceae* and in those of the *Cyperaceae*.

Upon considering all these anatomical characters, I shall now give the following key to all the species treated in this paper.

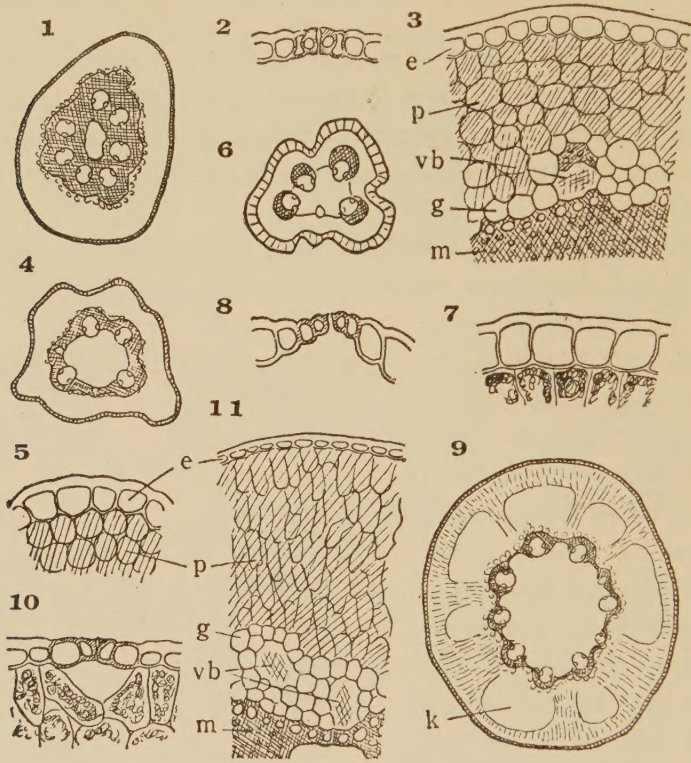


Fig 4. Cross section of the various kinds of peduncles in *Juncus*. 1-3. *J. Fauriei* LÉVEIL. et VAN. 4-5. *J. curvatus* BUCHEN. 6-8. *J. Maximowiczii* BUCHEN. 9-11. *J. castaneus* SMITH. 2, 8, 10. stomata; 5, 7. epidermes; 3, 11. peripheral portions of the peduncles; e. epidermal cell; p. cortex; g. parenchyma-sheath; m. mechanical tissue; vb. vascular bundle; k. peripheral cavity found in the cortex. 1, 4, 6 = $\times 50$; 9 = $\times 25$; 2, 3, 5, 7, 8, 10, 11 = $\times 225$.

Key to the Species.

- 1 { Epidermal cell has a prominence on the outer side. Stomata located under the level of the epidermis, namely, the guard-cells situated at the lower part than the subsidiary cells which exist again at the lower part than the epidermal cells.....
..... *J. prominens* (Fig. 3.-1, 2)
Epidermal cell has no prominence. Stomata located on the same level of the epidermis, namely, the guard-cells situated at the upper part of the subsidiary cells which also sit at the upper part of the epidermal cells 2

- 2 { Epidermal cells oval, and their cell-walls nearly all alike in thickness. The subsidiary cells one half as long as the epidermal cells in radial length *J. alatus* (Fig. 1.-3)
..... *J. oligocephalus* (Fig. 2.-5, 6)
..... *J. papillosus*
- 3 { Epidermal cells nearly rectangular, and their outer cell-walls strongly thickened. The subsidiary cells as large as or somewhat smaller, or larger than the epidermal cells ... 3
- 3 { All parenchymatous cells polygonal or rounded, but never form palisade tissue 4
1-2 layers of parenchymatous cells, lying close to the epidermis, form palisade tissue... 5
- 4 { Mechanical tissues remarkably developed into a broad circular band in which vascular bundles are embedded *J. Fauriei* (Fig. 4.-1)
..... *J. Haenkei*
- 4 { Mechanical tissues form a narrow circular band, which cover only the outer sides of the vascular bundles *J. curvatus* (Fig. 4.-4)
..... *J. filiformis*
- 5 { Subsidiary cells as long as or a little longer than the epidermal cells in radial length 6
Subsidiary cells much shorter than the epidermal cells in radial and tangential lengths 8
- 6 { Mechanical tissues present in the shape of half-moon only on the outer sides of vascular bundles *J. triglumis* (Fig. 2.-7)
Mechanical tissues form a narrow circular band 7
- 7 { Subsidiary cells longer than the epidermal cells in tangential length, and the guard-cells as long as or a little shorter than the subsidiary cells in radial length.....
..... *J. castaneus* (Fig. 4.-10)
Subsidiary cells shorter than the epidermal cells in tangential length, and the guard-cells much smaller than the subsidiary cells *J. kamschatcensis*
..... *J. Mertensianus*
..... *J. decipiens*
- 8 { Epidermal cells rectangular and very large. Lunate mechanical tissues present only on the outer sides of the vascular bundles *J. Maximowiczii* (Fig. 4.-7)
Epidermal cells small. Mechanical tissues form a circular band.....
..... *J. beringensis* (Fig. 1.-2)
..... *J. bufonius* (Fig. 2.-1, 2, 3)
..... *J. Kramerii*
..... *J. tenuis*

2. *Luzula*.

The structure of the peduncles of *Luzula* very much resembles that of *Juncus*. The species on which this study is based are *Luzula capitata* NAKAI, *L. rostrata* BUCHENAU, *L. plumosa* MEYER, *L. multiflora* LEJEUNE and *L. Wahlenbergii* RUPRECHT.

The epidermal cells and stomata are all just the same as those of *Juncus tenuis* and *J. Kramerii*.

The cortex consists of irregularly rectangular or rounded parenchymatous

cells, and even in the case where the cortex is composed of rectangular cells, the cells in one layer which are lying close to the epidermis are rounded and clearly distinguishable from the other parenchymatous cells.

The mechanical tissues exist circumscribing each of the different vascular bundles, but do not develop into a circular band (Fig. 5.-1, 6), except those of *Luzula Wahlenbergii* (Fig. 5.-4).

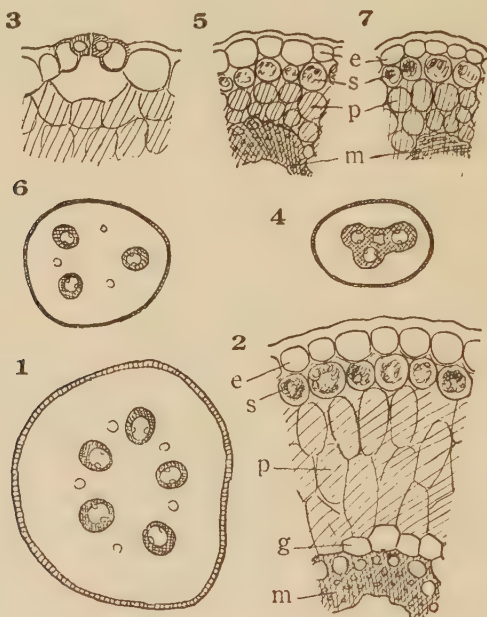


Fig. 5. Cross section of the various kinds of peduncles in *Luzula*. 1-3. *L. capitata* NAKAI. 4-5. *L. Wahlenbergii* RUPR. 6-7. *L. plumosa* MEYER. 3. stoma; 2, 5, 7. peripheral portions of the peduncles; e. epidermal cell; p. cortex; s. rounded cell in cortex, lying close to the epidermis; g. parenchyma-sheath; m. mechanical tissue. 1, 4, 6 = $\times 50$; 2, 3, 5, 7 = $\times 225$.

Parenchyma-sheath which is very distinctly seen in *Juncus* is mostly obscure or nearly absent, except in *Luzula capitata* (Fig. 5.-2). In the following lines, I shall give a key to the species with reference to the above mentioned characters.

Key to the Species.

- | | | |
|-----|--|---|
| 1 { | Parenchymatous cells rounded..... | 2 |
| | Parenchymatous cells irregularly rectangular or oblong | 3 |

- | | | | |
|---|---|--|--|
| 2 | { | Mechanical tissues remarkably developed into a thick circular band with a small pith in the centre, and a number of vascular bundles embedded in the mass..... | <i>L. Wahlenbergii</i> (Fig. 5.-4) |
| | | Mechanical tissues exist around each of the vascular bundles, but never form a circular band | <i>L. plumosa</i> (Fig. 5.-6) |
| 3 | { | Parenchyma-sheath mostly distinct | <i>L. capitata</i> (Fig. 5.-2) |
| | | Parenchyma-sheath obscure..... | <i>L. multiflora</i> |
| | | Parenchyma-sheath nearly absent..... | <i>L. rostrata</i> |

c. Systematic Importance of the Anatomy of Peduncles.

From the view-point of the anatomy of peduncles, the two genera, *Juncus* and *Luzula* are different with respect to the cortex, mechanical tissue and parenchyma-sheath. In the former the cortex consists of oblong or elongated parenchymatous cells, the mechanical tissue exists usually in the form of a circular band, and the parenchyma-sheath is distinctly seen; while in the latter the cortex is composed of rounded parenchymatous cells, the mechanical tissue is separated into several circles each of which surrounds a vascular bundle, and the parenchyma-sheath is obscurely seen.

Juncus prominens (Fig. 1.-5; Fig. 3) and *J. falcatus* belonging to the subgenus *Graminifolii* are distinctly separable from other subgenera, or even from other species of the same subgenus, in having depressed stomata and elevated epidermal cells. It may be better to regard them as representing a peculiar group.

Juncus alatus (Fig. 1.-3), *J. papillosus* and *J. oligocephalus* (Fig. 2.-5, 6) resemble one another very much in having oval and thin-walled epidermal cells, and form a group in the subgenus *Septati*.

Juncus Fauriei (Fig. 4.-3), *J. Haenkei*, *J. curvatus* (Fig. 4.-5) and *J. filiformis* belonging to the subgenus *Genuini* are closely related to each other in having polygonal or round parenchymatous cells, with no palisade tissue whatever. This is a sole point by which I would think that they are somehow related to some of *Luzula*.

Juncus beringensis (Fig. 1.-2) belonging to the subgenus *Genuini* comes rather near to *J. tenuis* or *J. bufonius* (Fig. 2.-1, 2, 3) which are assignable to the subgenus *Poiophylli*. As far as are concerned scobiformed seed and different structure of the peduncles, *J. beringensis* is better to be separated from the subgenus *Genuini* and should be regarded as representing a new subgenus.

Juncus triglumis (Fig. 2.-7), *J. Maximowiczii* (Fig. 4.-6) and *J. castaneus*

(Fig. 4.-9) have mostly undeveloped mechanical tissues which are situated only on the outer side of the vascular bundles in lunate shape, and consequently it is proper to assign them to the subgenus *Alpini*. Upon considering all the above cases, I am forced to conclude that the structure of the peduncles of *Juncus* is in some cases reliable in determining groups or subgenera. Regarding *Luzula*, as I was unable to make a full examination on the peduncles on account of the lack of material, I shall put it aside in the present discussion.

II. Systematic Anatomy of Carpels.

That the shape, colour and size of the carpels as well as the inner structure of the latter are the most important criteria in the classification of the *Juncaceae* has already been recognized by many authors, such as MEYER (40, 41), ENGELMANN (13), BUCHENAU (4-6) and others. But none of them has ever published any detailed account on the anatomy of carpels. In his paper entitled „Ueber den Querschnitt der Kapsel der deutschen Juncus-Arten,“ BUCHENAU divides the ovaries of *Juncus* into four groups, i.e.—unilocular, trilocular, triseptate and incompletely trilocular, and moreover he distinguishes thick carpels from delicate and thin ones, but does not give any account on their minute structure. We have already many literature on the anatomy of the carpels on other families, while there is practically none at all on the *Juncaceae* except a paper by KRAUS (11).

Now it is my desire to give a full note on the structure of carpels and to enter into a discussion on its value on the taxonomy of this family.

a. Technical Method.

As materials, I used mainly dry specimens preserved in the Herbarium of the Botanical Institute, Faculty of Science, Imperial University of Tokyo, and also dry or raw specimens which were given to me by my seniors and friends or collected by myself. Observation is done on cross sections obtained from the middle portion of mature carpels.

In the *Juncaceae*, there are different kinds of carpels—hard and thick ones of *Juncus prominens*, *J. Haenkei* and *J. beringensis*, or thin and tender ones of *Juncus prismatocarpus* var. *Leschenaultii*, *J. papillosus*, *J. bufonius* and *Luzula*-species. The former is very easy to be sectioned, while on the contrary, the latter is rather difficult to be cut. In some cases dry material is more con-

venient for the manipulation, but in other cases raw material is more suitable for the work. As a rule, in some species with hard and thick carpels it is better to use dry materials, while in other species with thin and tender carpels raw materials are preferable. Sections observed in my work are made by hands, and are stained with safranin to examine the degree of lignification; after the staining, sections are taken into 50% alcohol for a few minutes, then they are taken into 50% glycerin, put on a slide under a cover glass and then observed. It is better not to embed the sections in Canada balsam, as we can thus observe the sections in their natural form without being shrunk as a result of dehydration.

**b. Structure of Carpels, Analytical Key to the Species,
and Descriptions of Carpels.**

1. *Juncus*.

For convenience sake, I shall treat the carpels of the genus as being composed of three different parts, namely, epidermes in the outer and inner surfaces, parenchyma and placenta. The epidermis in the outer surface is composed of lignified cells arranged in one layer which cells are always thickened on the outer side in their walls and are in lunate shape in cross section. It is often covered with cuticle. The epidermis in the inner surface consists of cells in one layer, which cells are somewhat lignified or sometimes not lignified, and are thickened a little on the outer side or not at all thickened. As the long axis of the epidermal cells in the outer surface of a carpel are, when observed superficially, parallel to the axis of the placenta, we can properly imagine the true shape of the epidermal cells in observing them only in their cross sections. The long axis of the epidermal cells in the inner surface are, however, not parallel to the axis of the placenta, but make some angle with it, and therefore we can not picture to ourselves their true shape by seeing only the cross section. The parenchyma consists of ordinary parenchymatous cells and is located between the epidermes of both outer and inner surfaces, and is neither lignified nor thickened, except in a few species. On the dehiscing sides of carpels, there are often more or less lignified cells which are apparently derived from the parenchymatous cells. The presence or absence of these lignified cells is very important in the classification of the species. Placenta is situated at the middle portion on the inner side of carpels.

By the forms of the placentae, the carpels of the species of the genus are

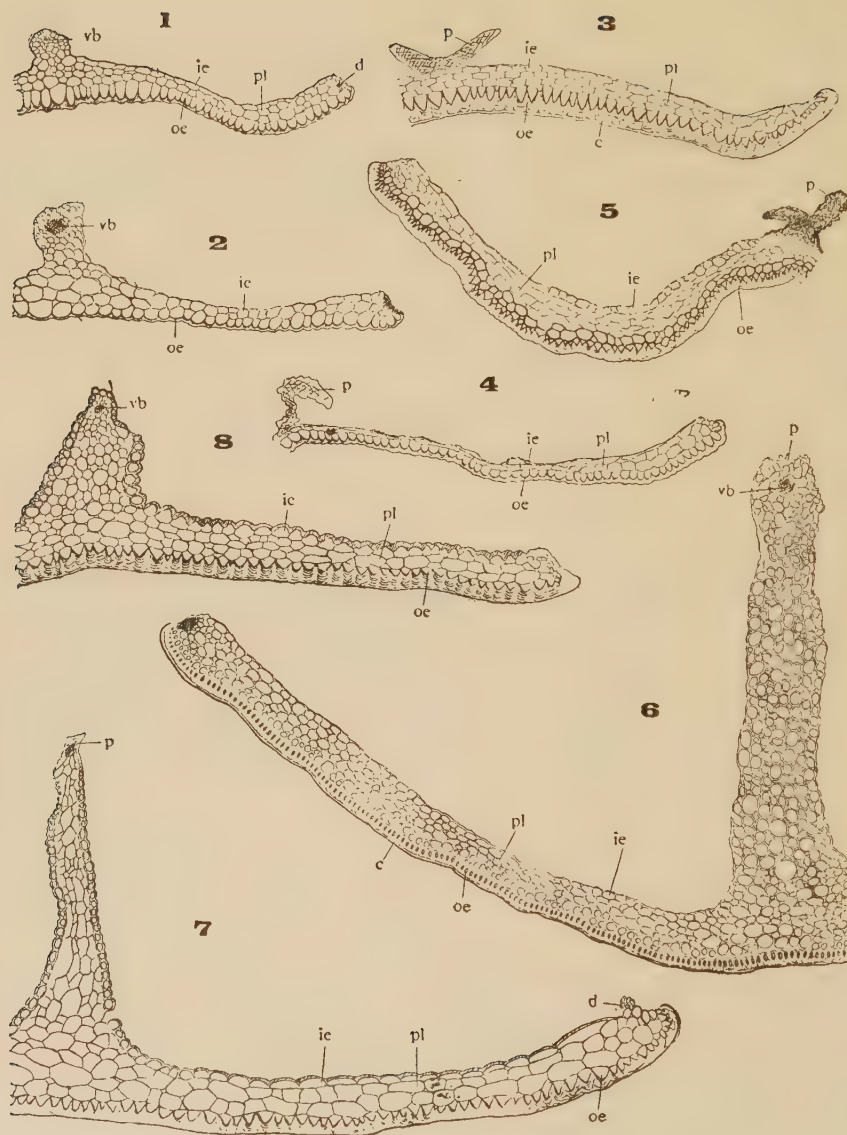


Fig. 6. Cross section of various kinds of carpels in *Juncus*. 1. *J. oligocephalus* SATAKE et OHWI. 2. *J. papillosus* FRANCH. et SAVAT. 3. *J. alatus* FRANCH. et SAVAT. 4. *J. Maximowiczii* BUCHEN. 5. *J. triglumis* LINN. 6. *J. castaneus* SMITH. 7. *J. beringensis* BUCHEN. 8. *J. Fauriensis* BUCHEN. ie. epidermis in the inner surface; oe. epidermis in the outer surface; c. cuticle; pl. parenchymatous cell; p. placenta; vb. vascular bundle; d. lignified cells on the dehiscing side. 1, 3, 4, 5, 8 = $\times 75$; 2, 6, 7 = \times ca. 83.

generally divided into three groups; 1) those belonging to the first group have no septum, namely, the placentae are directly located at the middle portions of carpels, and the group is called "*Capsulae uniloculares*"; 2) those belonging to the second group have septa which are located at the middle portions of the carpels, namely the placentae are at the free margins of the septa which do not unite at the centre of the capsule, and this group is called "*Capsulae triseptatae*"; 3) those of the third group have three septa which spread from the middle portions of carpels, extend towards the centre and unite there with each other; in this case the placentae are on lateral sides of the septa, and the capsule is completely divided into three rooms; the group is called "*Capsulae triloculares*."

These differences of carpels just mentioned were already pointed out by ENGELMANN, BUCHENAU and other taxonomists, but none of them has ever given any detailed observation. I have therefore taken up this opportunity of studying the structure of carpels more precisely and have tried to explain how far the anatomical characters of carpels afford us the important criteria in the classification of *Juncus*. In the following pages I shall describe the structure of the carpels of each different species.

Group I. *Capsulae uniloculares*: To this group, belong *Juncus alatus* (Fig. 6.-3), *J. triglumis* (Fig. 6.-5), *J. Maximowiczii* (Fig. 6.-4), *J. prismatocarpus* var. *Leschenaultii*, *J. diastrophanthus*, *J. Mertensianus* *J. papillosus* (Fig. 6.-2), *J. oligocephalus* (Fig. 6.-7) and *J. Krameri*. The epidermal cells in the outer surface of a carpel are lignified and so thickened on the outer side of cell-walls that they appear like a crescent in cross section (Fig. 6.-oe). Cuticle is scarcely present. The epidermal cells in the inner surface of a carpel are neither lignified nor thickened (Fig. 6.-1, 2, 3, ie). The cells on the dehiscing sides of a carpel are also not lignified, except those in *Juncus oligocephalus* (Fig. 6.-1, d). The parenchyma between two epidermes (in the outer and inner surfaces of a carpel) consists of two or fewer layers of ordinary parenchymatous cells, except that in *Juncus triglumis*.

Group II. *Capsulae triseptatae*: This group is conveniently subdivided into two divisions; 1) the free margin of a septum is not swollen; and 2) the free margin of a septum is somewhat or remarkably swollen. To the former division belong *Juncus castaneus* (Fig. 6.-6), *J. beringensis* (Fig. 6.-7), *J. Fauri-ensis* (Fig. 6.-8) and *J. kamschatcensis* (Fig. 7.-3). In these species the epidermal cells in the outer surface of a carpel are all lignified, their cell-walls are thickened on the outer side, and appear like a crescent in cross section,

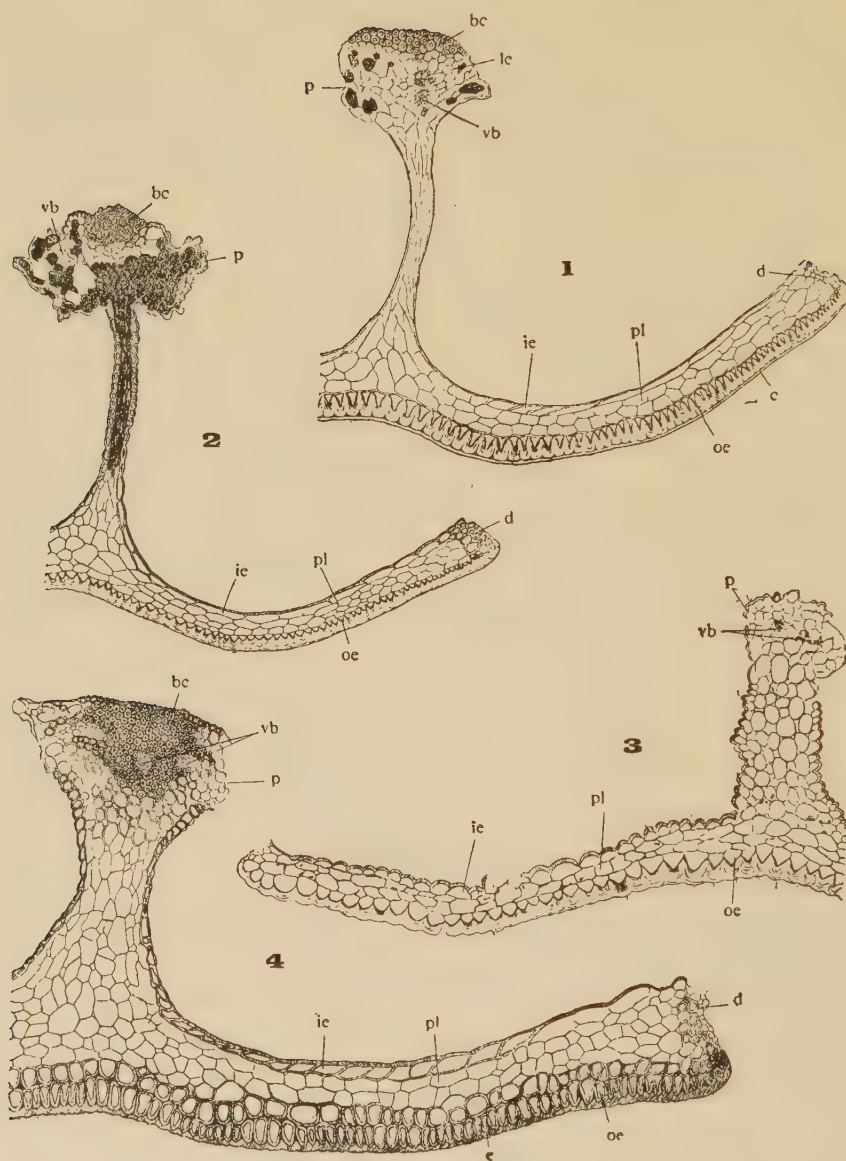


Fig. 7. Cross section of the various kinds of carpels in *Juncus*. 1. *J. compressus* var. *gracillimus* BUCHEN. 2. *J. Fauriei* LÉVEIL, et VAN. 3. *J. kamschatcensis* KUDÓ. 4. *J. Haenkei* MEYER. ie, epidermis in the inner surface of a carpel; oe, epidermis in the outer surface of a carpel; c, cuticle; pl, parenchymatous cell; p, placenta; vb, vascular bundle; bc, sclerenchyma; lc, lignified cells; d, lignified cells on dehiscent sides. 1, 2 = $\times 75$; 3, 4 = \times ca. 83.

except those of *Juncus castaneus* in which the epidermal cells in the outer surface of a carpel are lignified, their cell-walls are thickened on all sides and are seen like a black-letter **O** in cross section (Fig. 6.-6, oe). Cuticle is found only in *Juncus castaneus* (Fig. 6.-6, c). The epidermal cells in the inner sur-

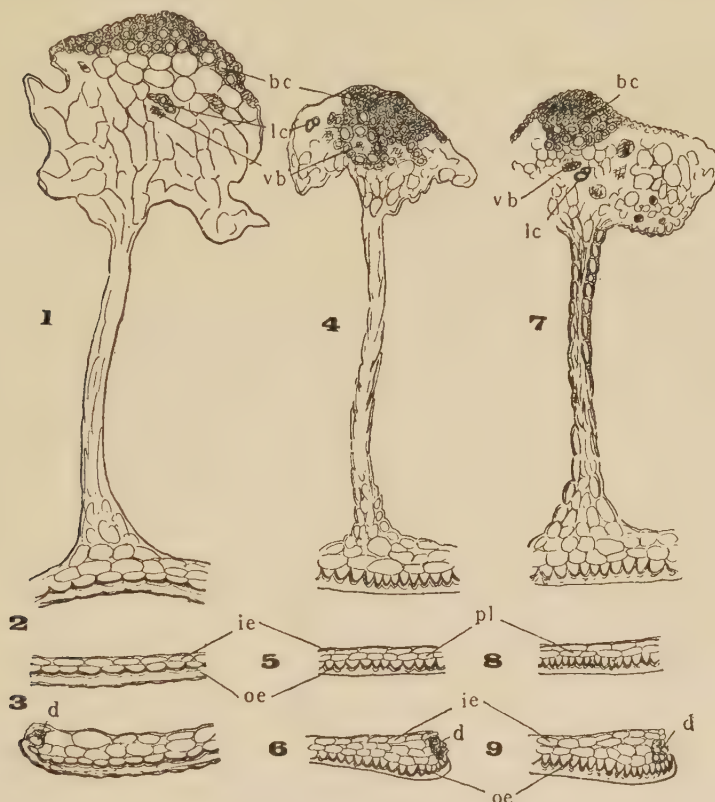


Fig. 8. Cross section of the various kinds of carpels in *Juncus*. 1-3. *J. bufonius* LINN. 4-6. *J. curvatus* BUCHEN. 7-9. *J. filiformis* LINN. 1, 4, 7. cross sections of the middle portions of carpels together with septa; 2, 5, 8. cross sections of the middle portions of carpels between the septa and the margins of the latter; 3, 6, 9. cross sections of the margins of carpels where capsule is dehiscing. ie. inner epidermis; oe. outer epidermis; pl. parenchymatous cell; lc. lignified cells; bc. sclerenchyma; vb. vascular bundle; d. lignified cells on dehiscing side. $\times 100$.

face of a carpel are lignified and more or less thickened on the outer sides of cell-walls, except in *Juncus castaneus*. Parenchyma consists of usually 2 layers (3-4 layers in *Juncus castaneus*) of parenchymatous cells and not at all lignified. In *Juncus castaneus* a layer of parenchymatous cells, situated close

to the epidermis in the outer surface of a carpel, are more or less lignified. The cells on the dehiscing sides of a carpel are neither lignified nor thickened, except in *Juncus beringensis*. Vascular bundles in the placenta are 1-3 in number.

To the latter division belong *Juncus Haenkei* (Fig. 7.-4), *J. Fauriei* (Fig. 7.-2), *J. filiformis* (Fig. 8.-7, 8, 9), *J. curvatus* (Fig. 8.-4, 5, 6), *J. brachyspathus*, *J. tenuis* (Fig. 9.-1), *J. compressus* var. *gracillimus* (Fig. 7.-1) and *J. setchuensis* var. *effusoides* (Fig. 9.-2). In these species just mentioned, the epidermal cells in the outer surface of a carpel are all lignified and thickened on the outer sides and appear like a crescent in cross section, except in *Juncus Fauriei* and *J. setchuensis* var. *effusoides*. In the latter two species the epidermal cells in the outer surface of a carpel are thickened in their cell-walls on the outer and two lateral sides and are seen like a black-letter **U** in cross section (Fig. 7.-2, oe; Fig. 9.-2, oe). Cuticle is remarkably developed in *Juncus Haenkei*, *J. Fauriei* and *J. setchuensis* var. *effusoides*. The epidermal cells in the inner surface of a carpel are not lignified, except in *J. Haenkei* and *J. compressus* var. *gracillimus*. Only in *J. setchuensis* var. *effusoides*, the epidermis of a septum is lignified (Fig. 9.-2). The parenchyma consists of 1-3 layers of non-lignified parenchymatous cells. In *J. Haenkei* the parenchymatous cells in one layer, which are lying close to the epidermis in the outer surface of a carpel, are so lignified and thickened that the epidermis would have consisted of two layers of lignified and thickened cells (Fig. 7.-4, oe). In *J. Haenkei*, *J. Fauriei*, *J. curvatus*, *J. filiformis*, *J. brachyspathus* and *J. compressus* var. *gracillimus*, we see sclerenchyma which consists of lignified sclerenchymatous cells and which is situated close to the epidermis at the free margin of a septum. Vascular bundles are usually 3 in number and are often surrounded by the sclerenchyma. The cells on the dehiscing sides of a carpel are all lignified, except in *Juncus tenuis* and *J. setchuensis* var. *effusoides* in which we find but 1-2 lignified cells.

Group III. **Capsulae triloculares**: To this group belong *Juncus decipiens* (Fig. 9.-3), *J. bufonius* (Fig. 8.-1, 2, 3) and *J. prominens* (Fig. 9.-4). The epidermal cells in the outer surface of a carpel are lignified and thickened on the outer side cell-walls and are seen like a crescent in cross section, except those of *J. bufonius* in which the outer cell-walls appear like an arch. Cuticle is absent. The epidermis in the inner surface of a carpel is lignified only in *Juncus prominens*. A remarkably lignified sclerenchyma is found only in *Juncus bufonius* (Fig. 8.-1, bc). In *Juncus prominens* there are several lignified



Fig. 9. Cross section of the various kinds of carpels in *Juncus*. 1. *J. tenuis* WILLD. 2. *J. setchuensis* var. *effusoides* BUCHEN. 3. *J. decipiens* NAKAI. 4. *J. prominens* MIYABE et KUDŌ. ie. epidermis in the inner surface; oe. epidermis in the outer surface; c. cuticle; pl. parenchymatous cell; p. placenta; vb. vascular bundle; lc. lignified cell; d. lignified cell on the dehiscing side. 1-3 = $\times 75$; 4 = \times ca. 83.

cells in the neighbourhood of the vascular bundles. The vascular bundles are 2-3 in number. The layers of parenchyma vary from one to three. The cells on the dehiscing sides are all lignified.

I may summarize once more the most important points necessary to classify the groups or to determine the species.

- 1) Whether the capsule is with or without septa, and the free margin of a septum swollen or not swollen; 2) Various states of thickening of cell-walls of the epidermis in the outer surface of a carpel; 3) Whether the epidermal cells in the inner surface of a carpel are lignified or not; 4) The number of the layers of the parenchyma; 5) Presence or absence of sclerenchyma in the free margin of a septum; 6) The number of vascular bundles in the placenta; 7) Whether the cells on the dehiscing sides of a carpel are lignified or not; 8) Thickness and width of a carpel.

At this point, I shall give an analytical key to the species, based on the anatomical characters of carpels just mentioned.

Key to the Species.

- | | | |
|---|---|----------------------|
| 1 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Capsule unilocular 2 </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Capsule triseptate 7 </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Capsule trilocular 17 </div> </div> | |
| 2 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Cells on the dehiscing sides of a carpel lignified..... <i>J. oligocephalus</i> (Fig. 6.-1) </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Cells on the dehiscing sides of a carpel not lignified 3 </div> </div> | |
| 3 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Parenchyma consists of 3-4 layers of parenchymatous cells. The cells in one layer, lying close to the epidermis in the outer surface of a carpel, more or less lignified <i>J. trigumis</i> (Fig. 6.-5) </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Parenchyma consists of 1-2 layers of parenchymatous cells, or absent 4 </div> </div> | |
| 4 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Parenchyma absent <i>J. papillosus</i> (Fig. 6.-2) </div> </div> | <i>J. nikkoensis</i> |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Parenchyma consists of 1-2 layers of parenchymatous cells 5 </div> </div> | |
| 5 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Carpel 0.08 mm. thick. Parenchyma consists of 2 layers of cells 6 </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Carpel 0.05 mm. thick. Parenchyma consists of 1 layer of cells <i>J. Maximowiczii</i> (Fig. 6.-4) </div> </div> | |
| 6 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Epidermal cells in the outer surface of a carpel remarkably thickened and undulatedly elevated on the outer side <i>J. Mertensianus</i> </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Epidermal cells in the outer surface of a carpel thickened, but not elevated on the outer side, as in the above case..... <i>J. alatus</i> (Fig. 6.-3) </div> </div> | |
| 7 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> The free margin of a septum not incrassate 8 </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> The free margin of a septum incrassate 11 </div> </div> | |
| 8 | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Epidermal cells in the outer surface of a carpel lignified, their cell-walls thickened on the wall all round, and look like a black-letter O in cross section. Epidermal cells in the inner surface of a carpel not at all lignified <i>J. castaneus</i> (Fig. 6.-6) </div> </div> | |
| | <div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 5px;">{</div> <div style="flex-grow: 1;"> Epidermal cells in the outer surface of a carpel lignified, their cell-walls thickened only on the outer side, and look like a crescent in cross section. Epidermal cells in the inner surface of a carpel lignified 9 </div> </div> | |

- 9 { Septum long, i.e. about one-third as long as a carpel in cross section. Cells on the
dehiscing sides lignified..... *J. beringensis* (Fig. 6.-7)
Septum short, i.e. about one-fourth as long as a carpel in cross section. Cells on the
dehiscing sides not lignified 10
- 10 { Epidermis on the free margin of a septum lignified. A single vascular bundle exists in
the placenta *J. Fauriensi* (Fig. 6.-8)
Epidermis on the free margin of a septum scarcely lignified. 3 vascular bundles present
in the placenta *J. kamschatcensis* (Fig. 7.-3)
- 11 { Parenchymatous cells in one layer, lying close to the epidermis in the outer surface of
a carpel as much lignified as the epidermal cells; epidermis looking in cross section
as if composed of 2 layers of cells..... *J. Haenkei* (Fig. 7.-4)
No parenchymatous cell lignified. Epidermis in the outer surface of a carpel clearly
composed of 1 layer of lignified cells 12
- 12 { Epidermal cells in the outer surface of a carpel lignified, their cell-walls thickened only
on the outer side, and look like a crescent in cross section 13
Epidermal cells in the outer surface of a carpel lignified, their cell-walls thickened
on the outer and two lateral sides, and look like a black-letter **U** in cross
section 16
- 13 { Sclerenchyma present in the free margin of a septum 14
Sclerenchyma absent in the free margin of a septum *J. tenuis* (Fig. 9.-1)
- 14 { Epidermal cells in the inner surface of a carpel not lignified. Vascular bundles embedded
in the sclerenchyma *J. curvatus* (Fig. 8.-4)
Epidermal cells in the inner surface of a carpel more or less lignified. Vascular bundles
not entirely embedded in the sclerenchyma..... 15
- 15 { Epidermis of a septum and the free margin of the latter well lignified. Parenchyma
consists of 2 layers of cells *J. compressus* var. *gracillimus* (Fig. 7.-1)
Epidermis of a septum lignified a little. Parenchyma consists of 1 layer of cells.....
..... *J. filiformis* (Fig. 8.-7, 8, 9)
- 16 { Epidermis in the inner surface of a carpel not lignified. Sclerenchyma present in the
free margin of a septum..... *J. Fauriei* (Fig. 7.-2)
Epidermis in the inner surface of a carpel not lignified, but that of a septum lignified.
Sclerenchyma absent in the free margin of a septum
..... *J. setchuensis* var. *effusoides* (Fig. 9.-2)
- 17 { Epidermis in the inner surface of a carpel lignified. The free margin of a septum
dilated and a little reflexed towards the carpel. Mostly 2 vascular bundles present
in the placenta *J. prominens* (Fig. 9.-4)
Epidermis in the inner surface of a carpel not lignified. The free margin of a septum
swollen a little. 3 vascular bundles present in the placenta 18
- 18 { Sclerenchyma present in the free margin of a septum. Parenchyma absent
..... *J. bufonius* (Fig. 8.-1, 2, 3)
Sclerenchyma absent. Parenchyma consists of 1-3 layers of cells
..... *J. decipiens* (Fig. 9.-3)

DESCRIPTIONS OF CARPELS.

Group I. *Capsulae uniloculares*.1. *Juncus oligocephalus* SATAKE & OHWI (Fig. 6.-1).

Capsule unilocular. Carpel 0.96-1 mm. wide and 0.06 mm. thick, with no septum. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and appear crescent-shaped in cross section. Cuticle absent. Epidermal cells in the inner surface of a carpel not lignified. Parenchyma consists of 1 layer of cells. Placenta slightly elevated and situated at the middle of the inner surface of a carpel. 1-2 lignified cells visible on the dehiscing sides of a carpel in cross section.

2. *Juncus papillosus* FRANCHET & SAVATIER (Fig. 6.-2).

Capsule unilocular. Carpel 0.9-1 mm. wide and 0.05 mm. thick, with no septum. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and appear like a crescent in cross section. Cuticle absent. Epidermal cells in the inner surface of a carpel not lignified. Parenchyma absent in the middle portion between the placenta and the dehiscing side. Placenta slightly elevated and situated at the middle of the inner surface of a carpel. Cells on the dehiscing sides of a carpel not at all or very slightly lignified.

3. *Juncus alatus* FRANCHET & SAVATIER (Fig. 6.-3).

Capsule unilocular. Carpel 1.4-1.6 mm. wide and 0.08 mm. thick, with no septum. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and appear like a crescent in cross section. Cuticle absent. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of 2-3 layers of cells. Placenta situated at the middle of the inner surface of a carpel. Cells on the dehiscing sides not lignified.

4. *Juncus Mertensianus* BONGARD.

Capsule unilocular. Carpel 1.7-1.9 mm. wide and 0.06 mm. thick, with no septum. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and crescent-shaped in cross section. Cuticle more or less present on the epidermal cells in the outer surface of a carpel. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of 2 layers of cells. Cells on the dehiscing sides not lignified.

5. *Juncus Maximowiczii* BUCHENAU (Fig. 6.-4).

Capsule unilocular. Carpel 1.4–1.6 mm. wide and 0.05 mm. thick, with no septum.¹⁾ Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and look like a crescent in cross section. Cuticle absent. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of 1–2 layers of cells. Placenta situated at the middle of the inner surface of a carpel. Cells on the dehiscing sides not lignified.

6. *Juncus triglumis* LINNAEUS (Fig. 6.-5).

Capsule unilocular. Carpel 2.0–2.4 mm. wide and 0.08–0.1 mm. thick, with no septum.²⁾ Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and appear like a crescent in cross section. Cuticle absent. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of 3–4 layers of cells, and one layer of which, lying close to the epidermis, more or less lignified. Placenta situated at the middle of the inner surface of a carpel. Cells on the dehiscing sides not lignified.

Group II. *Capsulae triseptatae*.**7. *Juncus castaneus* SMITH (Fig. 6.-6).**

Capsule triseptate or incompletely trilocular. Carpel 2.25–2.55 mm. wide and 0.08 mm. thick. Septum 0.65–0.96 mm. long and 0.13 mm. thick, and much thicker than the carpel. The free margin of a septum not swollen. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on all sides and look like a black-letter **o** in cross section. Cuticle present. Epidermal cells in the inner surface of a carpel not lignified. Parenchyma consists of 4–5 layers of cells; one layer lying close to the epidermis lignified and their cell-walls somewhat thickened. Parenchyma-cells in a septum mostly rounded and some of them often thickened. Two vascular bundles visible in the placenta. Cells on the dehiscing sides not lignified.

8. *Juncus beringensis* BUCHENAU (Fig. 6.-7).

Capsule triseptate. Carpel 1.75–1.9 mm. wide and 0.08–0.12 mm. thick. Septum 0.48–0.65 mm. long and 0.08–0.12 mm. thick. The septum becomes thinner towards the free margin, but thicker towards its inserting portion on the carpel. Epidermal cells in the outer surface of a carpel lignified; their cell-

1), 2). Owing to the imperfectness of material, I was unable to decide whether the carpels of *J. Maximowiczii* and *J. triglumis* have septa or not.

walls thickened only on the outer side, and crescent-shaped in cross section. Cuticle absent. Epidermal cells in the inner surface of a carpel also lignified and their cell-walls somewhat thickened only on the outer side. Parenchyma consists of 2 layers of cells. One (?) vascular bundle present in the placenta. Cells on the dehiscing sides of a carpel lignified.

9. ***Juncus Fauriensis*** BUCHENAU (Fig. 6.-8).

Capsule triseptate or incompletely triseptate. Carpel 1.45-1.76 mm. wide and 0.08-0.1 mm. thick. Septum very short, 0.3 mm. long and 0.15 mm. thick. The septum becomes suddenly thin towards the free margin, but thicker towards its inserting portion on the carpel. Epidermal cells in the outer surface of a carpel well lignified; their cell-walls thickened only on the outer side, and appear crescent-shaped in cross section. Cuticle absent. Epidermal cells in the inner surface of a carpel all lignified and their cell-walls thickened on the outer side. Parenchyma consists of 1-3 layers of cells. A single (?) vascular bundle present in the placenta. Cells on the dehiscing sides not lignified.

10. ***Juncus kamschatcensis*** KUDÔ (Fig. 7.-3).

Capsule triseptate or incompletely triseptate. Carpel 1.76-1.9 mm. wide and 0.08-0.09 mm. thick. Septum 0.4 mm. long and 0.11-0.14 mm. thick, or thicker than the carpel, and swollen a little at the free margin. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and appear crescent-shaped in cross section. Cuticle scarcely seen. Epidermis in the inner surface of a carpel lignified up to that of a septum and their cell-walls thickened a little on the outer side. Parenchyma consists of 1-2 layers of cells. 1-2 epidermal cells of the free margin of a septum often lignified. 3 vascular bundles present in the placenta. Cells on the dehiscing sides not lignified.

11. ***Juncus Haenkei*** MEYER (Fig. 7.-4).

Capsule triseptate. Carpel 2.0-2.5 mm. wide and 0.12-0.14 mm. thick. Septum 0.56-0.65 mm. long, 0.11-0.16 mm. thick, and swollen a little at the free margin. Epidermal cells in the outer surface of a carpel lignified; their cell-walls remarkably thickened on all sides, and the cell-lumens look like an ellipse or a wedge. Cuticle remarkably visible. Parenchyma consists of 3 layers of cells, one layer of which, lying close to the epidermis in the outer surface, so lignified and thickened as the epidermis that it gives the impression of the epidermis being composed of 2 layers of cells. This is a remarkable characteristic of this species. Epidermis in the inner surface of a carpel also

lignified. Sclerenchyma present lying close to the epidermis of the free margin, and includes 3 vascular bundles in the mass. Cells on the dehiscing sides well lignified.

12. ***Juncus compressus*** JACQUIN var. ***gracillimus*** BUCHENAU (Fig. 7.-1).

Capsule triseptate. Carpel 1.6-1.75 mm. wide and 0.08 mm. thick. Septum 0.6 mm. long, 0.05 mm. thick, and swollen very much at the free margin which appears like a cap in cross section. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and look crescent-shaped in cross section. Cuticle present. Epidermis in the inner surface of a carpel also well lignified up to that of the free margin of the septum. Sclerenchyma present close to the epidermis of the free margin of a septum. 2-3 vascular bundles present in the placenta, but not surrounded by sclerenchyma. Parenchyma consists of 2-3 layers of cells, and the parenchymatous cells in a septum contain so much tanniferous substance that we are quite prevented from looking into the structure of the tissue, so far as I observed in my preparations. Cells on the dehiscing sides well lignified and thickened.

13. ***Juncus curvatus*** BUCHENAU (Fig. 8.-4, 5, 6).

Capsule triseptate. Carpel 2.3-2.4 mm. wide and 0.05 mm. thick. Septum 0.65 mm. long and 0.02-0.03 mm. thick; its free margin very much swollen and looks like a cap in cross section. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, being crescent-shaped in cross section. Cuticle absent. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of one layer of cells. Sclerenchyma located close to the epidermis of the free margin of a septum. 3 vascular bundles present in the placenta, and one or two of them surrounded by the sclerenchyma. Cells on the dehiscing sides lignified.

14. ***Juncus filiformis*** LINNAEUS (Fig. 8.-7, 8, 9).

Capsule triseptate. Carpel 2-2.5 mm. wide and 0.05 mm. thick. Septum 0.7 mm. long and 0.03 mm. thick; its free margin very much swollen and appears like a cap in cross section. Epidermal cells in the surface of a carpel lignified; their cell-walls thickened only on the outer side, being of crescent shape in cross section. Cuticle absent. Epidermis in the inner surface of a carpel not lignified, but that of a septum lignified. Parenchyma consists of one layer of cells. Sclerenchyma present close to the lignified epidermis of the

free margin of a septum. 3 vascular bundles visible in the placenta, each of them showing several lignified cells. Cells on the dehiscing sides lignified.

15. **Juncus Fauriei** LÉVEILLÉ et VANIOT (Fig. 7.-2).

Capsule triseptate. Carpel 1.9-2 mm. wide and 0.08 mm. thick. Septum 0.6-0.7 mm. long and 0.03-0.05 mm. thick; the free margin of it very much swollen and looks like a cap in cross section. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on the outer and two lateral sides, and appear like a black-letter **U** in cross section. Cuticle well developed. Epidermis in the inner surface of a carpel lignified a little. Parenchyma consists of two layers of cells. Sclerenchyma located close to the lignified epidermis of the free margin of a septum. Two vascular bundles visible, but not surrounded by the sclerenchyma. Several lignified cells found in the neighbourhood of the vascular bundles. Cells on the dehiscing sides lignified and thickened.

16. **Juncus setchuensis** BUCHENAU var. **effusoides** BUCHENAU (Fig. 9.-2).

Capsule triseptate. Carpel 1.9-2.2 mm. wide and 0.06-0.08 mm. thick. Septum 0.48-0.64 mm. long and 0.03-0.05 mm. thick; the free margin very much swollen and looks like a cap in cross section. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on the outer and two lateral sides, and look like a black-letter **U** in cross section, just as in **J. Fauriei**. Cuticle present. Epidermis in the inner surface of a carpel lignified only on the septum. Parenchyma consists of 2 (rarely 3) layers of cells. 3 vascular bundles present in the placenta. Several lignified cells seen in the free margin of a septum, but the sclerenchyma absent. 1-2 lignified cells seen on the dehiscing sides of a carpel.

17. **Juncus tenuis** WILLDENOW (Fig. 9.-1).

Capsule triseptate. Carpel 1.8-2 mm. wide and 0.05 mm. thick. Septum 0.48 mm. long and 0.02-0.03 mm. thick; the free margin dilated so as to look like a cap in cross section. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and appear crescent-shaped in cross section. Cuticle present. Epidermis in the inner surface of a carpel not at all lignified. Parenchyma consists of 1-2 layers of cells. Several lignified cells found in the free margin of the septum. 3 vascular bundles present in the placenta. Cells on the dehiscing sides scarcely lignified, or rarely 1-3 lignified cells found only.

Group III. **Capsulae triloculares.**18. **Juncus bufonius** LINNAEUS (Fig. 8.-1, 2, 3).

Capsule trilocular. Carpel 0.96-1 mm. wide and 0.03-0.04 mm. thick. Septum 0.7 mm. long and 0.02 mm. thick; the margins of the septa unite together at the centre of the capsule. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and appear like a broad arch in cross section. Cuticle absent. Epidermis in the inner surface of a carpel not lignified. Parenchyma absent. Sclerenchyma present, lying close to the lignified epidermis of the free margin of a septum. 3 vascular bundles present in the placenta. 1-2 lignified cells visible on the dehiscing sides of a carpel.

19. **Juncus decipiens** NAKAI (Fig. 9.-3).

Capsule trilocular. Carpel 1.3-1.4 mm. wide and 0.05 mm. thick. Septum 0.56 mm. long and 0.04-0.06 mm. thick. The margins of the septa unite together at the centre of the capsule. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and look like a crescent in cross section. Cuticle absent. Epidermis in the inner surface of a carpel somewhat lignified only on the septum. Parenchyma consists of 1-2 layers of cells. 3 vascular bundles present in the placenta, each of which surrounded by several lignified cells. Cells on the dehiscing sides lignified.

20. **Juncus prominens** MIYABE & KUDÔ (Fig. 9.-4).

Capsule trilocular. Carpel 2.4-2.6 mm. wide and 0.08-0.12 mm. thick. Septum 0.95-1.2 mm. long and 0.06-0.08 mm. thick. The margins of the septa dilated and somewhat flattened or reflexed. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and look like a crescent in cross section. Cuticle present. Epidermal cells in the inner surface of a carpel also lignified and thickened. Parenchyma consists of 2-3 layers of cells. Numerous cells in the middle part of the margin lignified, but not sufficiently thickened to form a sclerenchyma. Vascular bundles mostly 2 in number, each of which existing on each of the dilated portions on the margins of the septa. Cells on the dehiscing sides well lignified.

2. **Luzula.**

Species at my disposal for this work are limited to *Luzula capitata* NAKAI, *L. oligantha* SAMUELSSON, *L. plumosa* MEYER, *L. rufescens* var. *macrocarpa*

BUCHENAU and *L. rostrata* BUCHENAU, other species being unavoidably omitted, owing to the lack of good materials.

The capsule of the genus is always unilocular with 3 seeds. Placenta is situated at the base of the elevated costa at the middle of the carpel. The structure of carpels is generally the same as that of *Juncus*. Epidermal cells

in the outer surface of a carpel are always lignified, their cell-walls are usually thickened on the outer and two lateral sides, and they, therefore, appear like a black-letter **U** in cross section, their lumens being nearly rectangular (Fig. 10.-3, 4, 5, oe). In *Luzula oligantha* (Fig. 10.-1), the epidermal cells in the outer surface of a carpel are lignified, their cell-walls are thickened only on the outer side, and the lumens are half-moon-shaped in cross section, as we see in *Juncus*. Epidermal cells in the inner surface of a carpel are not at all or scarcely lignified or thickened. Parenchyma is entirely absent or if present consists of one layer. The cells on the dehiscing sides are a little

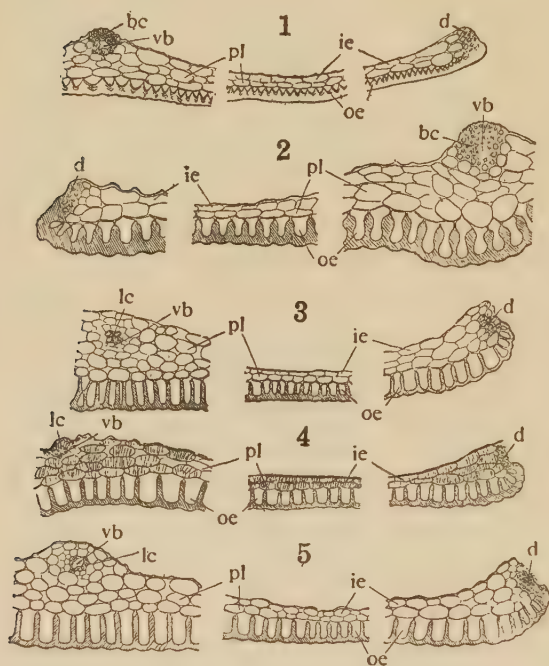


Fig. 10. Cross section of the various kinds of carpels in *Luzula*. 1. *L. oligantha* SAMUELS. 2. *L. capitata* NAKAI. 3. *L. plumosa* MEYER. 4. *L. rufescens* var. *macrocarpa* BUCHEN. 5. *L. rostrata* BUCHEN. ie, epidermis in the inner surface of a carpel; oe, epidermis in the outer surface of a carpel; pl, parenchymatous cell; vb, vascular bundle; lc, lignified cell; bc, sclerenchyma; d, lignified cell on dehiscing sides. 1, 2, 4, 5 = $\times 90$; 3 = $\times 100$.

or hardly lignified. A single vascular bundle is present in the placenta, and in some species it is surrounded by sclerenchyma which consists of many lignified fibrous cells.

The following is a key to the species with special reference to the anatomical characters just mentioned.

Key to the Species.

- | | | | |
|---|---|---|---|
| 1 | { | Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened only on the outer side, and look like a half-moon in cross section..... | <i>L. oligantha</i> (Fig. 10.-1) |
| | | Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on the outer and two lateral sides, and look like a black-letter U in cross section | 2 |
| 2 | { | Sclerenchyma present, in which a single vascular bundle is embedded..... | <i>L. capitata</i> (Fig. 10.-2) |
| | | Sclerenchyma absent | 3 |
| 3 | { | Cells on the dehiscing sides strongly lignified..... | <i>L. rostrata</i> (Fig. 10.-5) |
| | | Cells on the dehiscing sides scarcely lignified..... | 4 |
| 4 | { | Epidermis on the placenta and several cells close to it lignified and somewhat thickened | <i>L. rufescens</i> var. <i>macrocarpa</i> (Fig. 10.-4) |
| | | Epidermis on the placenta and several cells close to it not lignified | <i>L. plumosa</i> (Fig. 10.-3) |

DESCRIPTIONS OF CARPELS.

21. *Luzula oligantha* SAMUELSSON (Fig. 10.-1).

Carpel 1-1.15 mm. wide and 0.03-0.05 mm. thick. Epidermal cells in the outer surface of a carpel remarkably lignified; their cell-walls thickened only on the outer side, and appear half-moon-shaped in cross section, as we see in *Juncus*. Cuticle present. Epidermal cells in the inner surface of a carpel somewhat lignified and their cell-walls thickened a little. Parenchyma consists of one layer of cells. A single vascular bundle present in the placenta and surrounded by the sclerenchyma. Cells on the dehiscing sides strikingly lignified and thickened.

22. *Luzula capitata* NAKAI (Fig. 10.-2).

Carpel 2.3-2.7 mm. wide and 0.06-0.08 mm. thick. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on the outer and two lateral sides, and look like a black-letter **U** in cross section, their lumens being nearly rectangular. In the epidermal cells on the costa of carpels, the two lateral cell-walls more or less swollen in the portions close to the inner cell-walls, and their lumens dumb-bell-shaped in cross section. Cuticle absent. Epidermis in the inner surface of a carpel scarcely lignified. Parenchyma absent, if present consists of one layer. A single vascular bundle present in the placenta and surrounded by sclerenchyma. The cells on the dehiscing sides lignified and thickened.

23. ***Luzula rostrata* BUCHENAU (Fig. 10.-5).**

Carpel 2.5-2.7 mm. wide and 0.06-0.07 mm. thick. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on the outer and two lateral sides, and look like a black-letter **U** in cross section, their lumens being nearly rectangular. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of 1 layer of cells. A single vascular bundle present in the placenta and surrounded by several lignified cells. Cells on the dehiscing sides mostly well lignified and thickened.

24. ***Luzula plumosa* MEYER (Fig. 10.-3).**

Carpel 2.5-2.8 mm. wide and 0.07 mm. thick. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on the outer and two lateral sides, and appear like a black-letter **U** in cross section, the lumens being nearly rectangular. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of 1 layer of cells. A single vascular bundle present in the placenta. 2-3 lignified cells found near the vascular bundle. Cells on the dehiscing sides scarcely lignified.

25. ***Luzula rufescens* FISCHER var. *macrocarpa* BUCHENAU (Fig. 10.-4).**

Carpel 2.6-3 mm. wide and 0.07 mm. thick. Epidermal cells in the outer surface of a carpel lignified; their cell-walls thickened on the outer and two lateral sides, and look like a black-letter **U** in cross section, their lumens being nearly rectangular. Epidermis in the inner surface of a carpel not lignified. Parenchyma consists of 1 layer of cells. A single vascular bundle present in the placenta. Epidermis on the placenta and several cells lying close to it lignified and thickened. Walls of the epidermal cells in the inner surface and those of the parenchymatous cells finely striated on their surfaces.

c. Systematic Importance of the Anatomy of Carpels.

As I have spoken in the foregoing pages, it is generally accepted that the outer characters of carpels as well as the inner structure of the latter are to be regarded as the most important criteria in the classification of the *Juncaceae*. Of the two criteria just mentioned, so far as my present study is concerned, the inner structure is far more important. This is mainly due to the fact that a carpel is a kind of organs whose inner structure can not be easily affected by outer conditions. For example, *Juncus Haenkei* and *J. Fauriei* are very much the same in their outer characters and habits, and they both resemble *Juncus balticus* which is not yet found in our country. The former two species

were first considered by many botanists to be the varieties of the latter and named respectively as *J. balticus* var. *Haenkei* and var. *japonicus*. But when the carpels of these three plants are examined, they are easily distinguished from each other in having the different structure of the epidermis in the outer surface of a carpel. In *J. Haenkei*, the epidermis in the outer surface of a carpel looks as if composed of two layers of lignified and thickened cells, for one layer of parenchymatous cells, lying close to the essential epidermis, are lignified and thickened as much as the epidermis itself (Fig. 7. 4), while in *J. Fauriei* and *J. balticus*, the epidermis in the outer surface of a carpel consists of actually one layer of lignified and thickened cells and never looks as if composed of two layers as in *J. Haenkei*. In *J. Fauriei* the epidermal cells in the outer surface of a carpel are thickened on the outer and two lateral sides, and as they appear in cross sections are like a black-letter **U** (Fig. 7.-2); in *J. balticus*, on the other hand, the epidermal cells in the outer surface of a carpel are thickened only on the outer side and in cross section are like a crescent.

As we see in the above example, the carpels which manifest, in some cases, no distinct character in the outer morphology, show many different aspects in the inner structure.

III. Systematic Value of Seeds, especially of the Anatomy of Testae and Tegmenta.

No doubt, as in the classification of other families, seeds afford important criteria in that of the *Juncaceae*. But, because of the extremely minute forms of seeds in the latter family, in which seeds do not exceed 1 mm. in length even in the largest, they have not very much claimed the attention of taxonomists, except ENGELMANN (8) and BUCHENAU (3, 5, 6) who published their works on the characters of form, colour, size, testa and tegmen of seeds. But, as to the structure of the testa and tegmen, there is as yet practically no literature to be consulted. Now I shall give the result of my study on this point and try to explain how important a criterion they afford in the taxonomy of the Japanese *Juncaceae*.

a. Technical Method.

Observation is made in surface-view in water, after boiling dry seeds for some minutes and thus restoring them as possible to their natural form.

b. General Remarks on the Testae and Tegmenta of Seeds, and Key to the Species, with Special Reference to the Characters of Seeds.

The ovule of the *Juncaceae* has, without exception, two integuments, and when ripened the inner integument becomes the tegmen, and the outer one forms the testa which is a kind of bag and contains the body of the seed loosely or tightly.

1. *Juncus*.

The seeds of this genus are ascending or more or less erect, with a micropylar end at the insertion of the funicle and a chalazal one at the chalaza. They are in colour ferrugineous, yellowish brown, blackish brown or chestnut-coloured, and elliptical, obovate, ovate or oblanceolate in form, thicker at the chalazal than at the micropylar end. The chalazal ends of

the seeds are mostly obtuse or somewhat cuspidate with round apex, but the micropylar ends are abruptly or more gradually pointed.

The testa is mostly slightly elongated beyond both ends of the seed and forms a small membranaceous appendage, as we see in *Juncus alatus*, *J. Fauriei*, *J. tenuis* and *J. decipiens* (Fig. 14.-1, 3, 5; Fig. 15.-1, 3, 5). But, in other species, e. g. *Juncus Maximowiczii* (Fig. 12.-4), *J. kamschatcensis* (Fig. 12.-7), *J. beringensis* (Fig. 13.-1), these appendages become more conspicuous, and extend far beyond the seed itself as empty, tail-like and white sacs. Such seeds are called "scobiform." This elongation of the testa is of great diagnostic value, but the absolute or proportionate length of

the appendages is very variable even in the same capsule.

The tegmen manifests various kinds of rectangular or hexagonal reticulation and is the most important criterion of systematizing *Juncus*. By the kinds of reticulations of tegmenta, *Juncus* is generally divided into several groups.

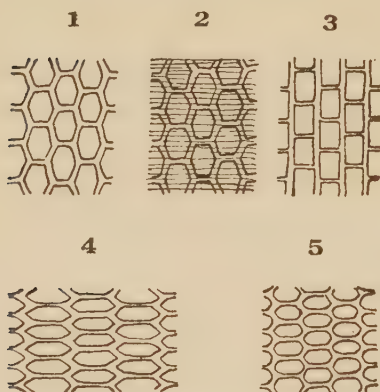


Fig. 11. Five different types of reticulations on the tegmenta of seeds in *Juncus*, shown diagrammatically. 1. **triglumis**-type seen in *J. triglumis*; 2. **alatus**-type seen in *J. alatus*; 3. **beringensis**-type seen in *J. beringensis*; 4. **Fauriei**-type seen in *J. Fauriei*; 5. **decipiens**-type seen in *J. decipiens*.

ENGELMANN (8) divides the genus into three groups:

1. Semina reticulata, vix seu distincte apiculata.
2. Semina transverse lineolata; levissime costata; vix seu distincte apiculata seu breviter caudata.
3. Semina costata, plus minus caudata.

He divides the first group again into 3 divisions, the second into 2 and the third into 3, according to the difference of the meshes.

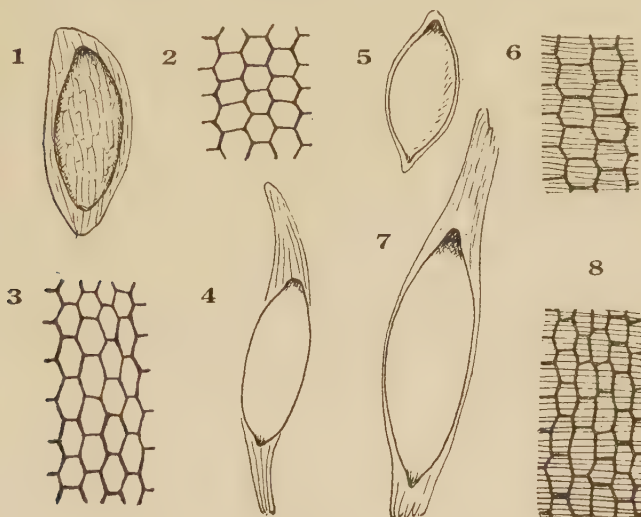


Fig. 12. 1-2. *Juncus prominens* MIYABE et KUDÔ. 3-4. *J. Maximowiczii* BUCHEN. 5-6. *J. prismatocarpus* var. *Leschenaultii* subv. *pluritubulosus* BUCHEN. 7-8. *J. kamschatcensis* KUDÔ. 1, 4, 5, 7. seeds; 2, 3, 6, 8. tegments; 1, 4, 5, 7 = \times ca. 33; 2, 3, 6 = \times ca. 100; 8 = \times ca. 65.

BUCHENAU (3) is of nearly the same opinion as ENGELMANN and divides *Juncus* as follows:

1. Samen nur (oder doch fast nur) mit Längsrippen: Semina costata.
2. Samen nur (oder doch fast nur) mit Querlinien: Semina lineolata.
3. Samen mit gleichmässigen Längs- und Querrippen: Semina reticulata.

And each of these groups is again divided into many divisions by the forms of reticulation.

These classifications by the two taxonomists seem at first sight to be so clear that there can be no confusion among the groups. But, that each of them is again divided into many divisions is very troublesome and sometimes very confusing, for many intermediate forms may come between one division

and another. I, therefore, propose here a new classification mainly following the opinions of the two botanists.

1. **triglumis**-type: i. e. the type of reticulation shown by *J. triglumis*.
2. **alatus**-type: i. e. the type of reticulation shown by *J. alatus*.
3. **beringensis**-type: i. e. the type of reticulation shown by *J. beringensis*.
4. **Fauriei**-type: i. e. the type of reticulation shown by *J. Fauriei*.
5. **decipiens**-type: i. e. the type of reticulation shown by *J. decipiens*.

In **triglumis**-type (Fig. 11.-1), the mesh is hexagonal, a little longer than broad, in the direction of the longitudinal axis of the seed, namely, two sides of the mesh parallel to the transversal axis of the seed are shorter than the length of the mesh, and the lines which make the mesh are all the same in thickness. To this group belong *Juncus triglumis*, *J. Maximowiczii* (Fig. 12.-3), *J. castaneus* and *J. prominens* (Fig. 12.-2).

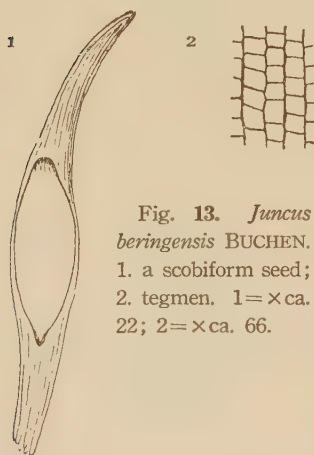


Fig. 13. *Juncus beringensis* BUCHEN.
1. a scobiform seed;
2. tegmen. 1 = \times ca.
22; 2 = \times ca. 66.

In **alatus**-type (Fig. 11.-2), the mesh is the same as that of the **triglumis**-type, but there are found, in addition to the lines forming the mesh, many fine lines parallel to the transversal axis of the seed. This kind of reticulation is most common in *Juncus*. To this group belong *Juncus alatus*, *J. Krameri*, *J. papillosus*, *J. diastrophanthus*, *J. Fauriensis*, *J. oligocephalus*, *J. kamschatcensis* (Fig. 12.-8) and *J. prismatocarpus* var. *Leschenaultii* (Fig. 12. 6).

In **beringensis**-type (Fig. 11.-3), the mesh is rectangular or irregularly rectangular whose longer sides are parallel to the longitudinal axis of the seed and the lines of the longer sides are thicker than those of the other sides which are parallel or nearly parallel to the transversal axis of the seed. The only species belonging to this group is *Juncus beringensis* (Fig. 13.-2).

In **Fauriei**-type (Fig. 11. 4), the mesh is hexagonal and its horizontal sides parallel to the transversal axis of the seed are longer than the other sides. It looks like a compressed form of the mesh of the **triglumis**-type. The right and left angles of the mesh are therefore acute; the lateral sides are not parallel to the longitudinal axis of the seed, but acutely curved and are more thickened than the transversal sides. To this group belong *J. Fauriei* (Fig. 14.-2), *J. compressus* var. *gracillimus* (Fig. 14.-6), *J. tenuis* (Fig. 14.-4) and *J. setchuensis* var. *effusoides*.

In *decipiens*-type (Fig. 11.-5), the mesh is nearly the same as that of *Fauriei*-type, but smaller in all ways than the latter, and the right and left

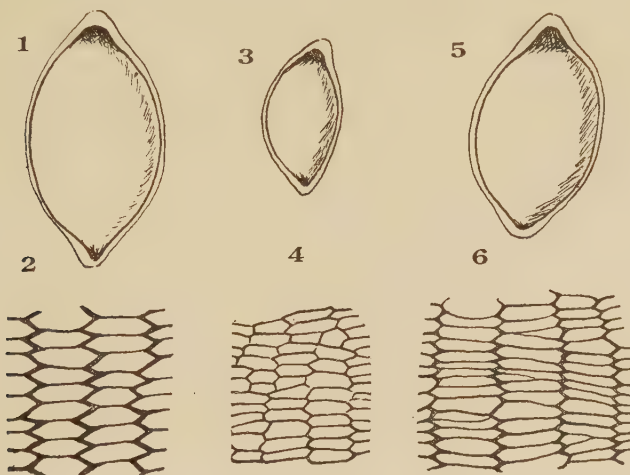


Fig. 14. 1-2. *Juncus Fauriei* LÉV. et VAN. 3-4. *J. tenuis* WILLD. 5-6. *J. compressus* var. *gracillimus* BUCHEN. 1, 3, 5. seeds; 2, 4, 6. tegmenta. 1, 3 = $\times 40$; 5 = \times ca. 53; 2, 4, 6 = $\times 120$.

sides are obtusely curved, but not so acutely as in the former type. To this group belong *Juncus decipiens*, *J. decipiens* var. *gracilis* (Fig. 15.-6), *J. bufonius* (Fig. 15.-2) and *J. Haenkei* (Fig. 15.-4).

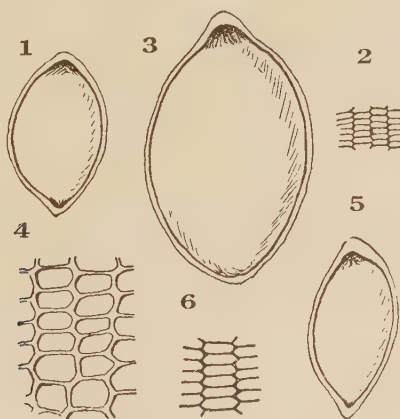


Fig. 15. 1-2. *Juncus bufonius* LINN. 3-4. *J. Haenkei* MEYER. 5-6. *J. decipiens* var. *gracilis* NAKAI. 1, 3, 5. seeds; 2, 4, 6. tegmenta. 1, 5 = \times ca. 33; 3 = $\times 40$; 2, 6 = \times ca. 106; 4 = $\times 120$.

	{	The mesh nearly rectangular, and its two sides parallel to the transversal axis of the seed shorter and thinner than the other sides	beringensis -type....	1
		<i>J. beringensis</i> (Fig. 13.-2)	
1	{	The mesh hexagonal, and its two sides parallel to the transversal axis of the seed shorter than the other sides. The lines making the mesh all the same in thickness.....		2
	{	The mesh hexagonal, and its two sides parallel to the transversal axis of the seed longer and thinner than the other sides		10
2	{	The mesh with many fine lines parallel to the transversal axis of the seed	alatus -type...	3
		The mesh without fine lines, as in the above	triglumis -type...	8
3	{	Seed scobiform, ca. 1 mm. long		4
		Seed conformed, ca. 0.65 mm. long		5
4	{	Seed elliptical, ca. 0.4 mm. broad	<i>J. Fauriensi</i> s	
		Seed oblong-elliptical, ca. 0.3 mm. broad	<i>J. kamschatcensis</i> (Fig. 12.-7, 8)	
5	{	Seed mucronate at the micropylar end.....		6
		Seed caudate at the micropylar end		7
	{	Seed ferrugineous, ca. 0.6 mm. long.....	<i>J. papillosus</i>	
		<i>J. diastrophanthus</i>	
6	{	Seed yolk-yellow, ca. 0.6 mm. long	<i>J. prismatocarpus</i> var. <i>Leschenaultii</i> (Fig. 12.-5, 6)	
		Seed yellow-ferrugineous, ca. 0.7-1 mm. long	<i>J. bombonzanensis</i> (Fig. 18.-2, 3)	
		Seed yellow-ochreous, ca. 0.65 mm. long.....	<i>J. nikkoensis</i> (Fig. 20.-4, 5)	
7	{	Seed ferrugineous	<i>J. alatus</i>	
		<i>J. oligocephalus</i>	
		Seed pale ferrugineous	<i>J. Krameri</i>	
8	{	Seed conformed, ca. 0.65 mm. long, or shorter.....	<i>J. prominens</i> (Fig. 12.-1, 2)	
		Seed scobiform, ca. 0.7 mm. long, or longer		9
9	{	Seed ca. 0.7-0.8 mm. long.....	<i>J. Maximowiczii</i> (Fig. 12.-3, 4)	
		Seed ca. 0.9-1 mm. long	<i>J. triglumis</i>	
		<i>J. castaneus</i>	
10	{	Right and left sides of the mesh acutely curved.....	Fauriei -type...	11
		Right and left sides of the mesh obtusely curved	decipiens -type...	13
11	{	Seed obovate or broadly obovate, ca. 0.75-0.8 mm. long	<i>J. Fauriei</i> (Fig. 14.-1, 2)	
		Seed obliquely obovate, ca. 0.6 mm. long, or shorter.....		12
12	{	Seed yolk-yellow or yellow-ferrugineous. Sides of the mesh nearly all the same in thickness.....	<i>J. tenuis</i> (Fig. 14.-3, 4)	
		Seed chestnut-coloured or ferrugineous. Sides of the mesh parallel to the transverse axis of the seed much thinner than the others	<i>J. compressus</i> var. <i>gracillimus</i> (Fig. 14.-5, 6)	
		<i>J. setchuensis</i> var. <i>effusoides</i>	
13	{	Seed ca. 0.8 mm. long, and 0.5 mm. broad	<i>J. Haenkei</i> (Fig. 15.-3, 4)	
		Seed ca. 0.65 mm. or shorter, and 0.35 mm. broad		14

- 14 { Seed obliquely obovate or elliptical, mucronate or caudate at the micropylar end ... 15
 { Seed obovate or cask-shaped, with obtuse micropylar end. Mesh very small
 *J. bufonius* (Fig. 15.-1, 2)
- 15 { Seed cuspidate at the chalazal, and mucronate at the micropylar end
 { *J. decipiens* var. *gracilis* (Fig. 15.-5, 6)
 { Seed obtuse at the chalazal, and caudate at the micropylar end *J. decipiens*

2. *Luzula*.

The seeds of the genus are ferrugineous, chestnut-coloured, red-brown or pale black in colour, elliptical, broadly ovate or somewhat round in form, and 1-1.5 mm. long and 0.6-1 mm. wide in size. The both chalazal and micropylar ends of the seed are usually obtuse or rounded, but not pointed as in those of *Juncus*.

The tegmen manifests always irregular or extremely obscure reticulation and is of far less diagnostic value in comparison with that of *Juncus*. The testa which is not so valuable in the case of *Juncus* is the most important characteristic. In the subgenus *Pterodes*, the testa develops at the chalazal end into a proper appendage which is called "chalazal caruncle" (Fig. 16.-3), but in the subgenus *Gymnodes* the testa develops at the micropylar end into a "micropylar caruncle" (Fig. 16.-5), although the subgenus *Anthelaea* have no caruncle at both ends (Fig. 16.-1). The caruncle of *Pterodes* is nearly as long as the seed, but that of *Gymnodes* is one half or one-third as long as the seed or shorter. The following is the key to the species.

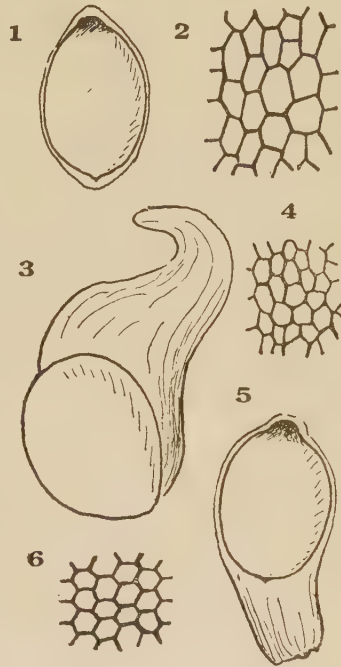


Fig. 16. 1-2. *Luzula effusa* BUCHEN. 3-4. *L. rostrata* BUCHEN. 5-6. *L. multiflora* LEJEUNE. 1. a seed without caruncle; 3. a seed with a large chalazal caruncle. 5. a seed with a micropylar caruncle; 2. irregularly hexagonal reticulation; 4. hexagonal reticulation. 1, 5 = $\times 15$; 3 = $\times 12$; 2 = $\times 100$; 4, 6 = $\times 50$.

Key to the Species.

- 1 { Caruncle present 2
 { Caruncle absent *Anthelaea* 9
- 2 { Caruncle large and exists only on the chalazal end of the seed *Pterodes* 3
 { Caruncle small and exists only on the micropylar end of the seed ... *Gymnodes* 6

3	{ Seed elliptical	4
	{ Seed broadly elliptical or broadly ovate	5
	{ Seed nearly spherical..... <i>L. plumosa</i> var. <i>sphaerosperma</i> (Fig. 22.-3)	
4	{ Seed ca. 1.6 mm. long and 1.2 mm. broad	<i>L. plumosa</i>
	{ Seed ca. 1 mm. long and 0.7 mm. broad	<i>L. plumosa</i> var. <i>brachycarpa</i> (Fig. 22.-4)
5	{ Seed ca. 1.6 mm. long.....	<i>L. rostrata</i> (Fig. 16.-3, 4)
	{ Seed ca. 1.3 mm. long	<i>L. rufescens</i> var. <i>macrocarpa</i>
6	{ Micropylar caruncle one half as long as the seed	7
	{ Micropylar caruncle very small	8
7	{ Reticulation of the tegmen irregularly hexagonal. Seed broadly elliptical and pale black	<i>L. capitata</i>
	{ Reticulation of the tegmen hexagonal. Seed broadly ovate or nearly spherical and chestnut-coloured.....	<i>L. multiflora</i> (Fig. 16.-5, 6)
8	{ Seed chestnut-coloured	<i>L. oligantha</i>
		<i>L. pallescens</i>
9	{ Seed black-brown.....	<i>L. taiwaniana</i> (Fig. 24.-4)
	{ Seed elliptical	<i>L. Wahlenbergii</i>
	{ Seed broadly elliptical or ovate	<i>L. effusa</i> (Fig. 16.-1, 2)

c. Systematic Importance of Seeds.

As we see in the foregoing pages, the characters of seeds afford us very important criteria in the classification of the *Juncaceae*. The reticulation in *Juncus* and the caruncle in *Luzula* are especially so peculiar that the genera are divided into several subgenera or groups.

In *Juncus*, the species belonging to *Septati* have usually reticulation of *alatus*-type, the species belonging to *Genuini* have mostly reticulation of *decipiens*-type, and the species belonging to *Alpini* have mostly reticulation of *triglumis*-type. *Juncus beringensis* has, although it belongs to *Genuini*, a peculiar reticulation which is never seen in other species.

In *Luzula*, the caruncle determines the subgenera. Thus the characters of the seeds must never be neglected in the classification of the *Juncaceae*.

The following tables show the different characters of seeds of the different species of *Juncus* and *Luzula*.

d. Tables showing the Different Characters of Seeds of Different
Species of the Japanese Juncaceae.

No. 1. *Junci Poiophylli* and *Septati*.

Sub- genera	Characters		Types of reticulation	Shapes	Colours	Sizes	
	Species					length	width
<i>Poiophylli</i>	<i>J. bufonius</i>		decipiens	obovate, cask-shaped	yellow-ferrugineous	0.6	0.3
	<i>J. compressus</i> v. <i>gracillimus</i>		compressus	obovate, obliquely ovate	chestnut-coloured, ferrugineous	0.5	0.3
	<i>J. leptocladus</i>		?	?	?	?	?
	<i>J. tenuis</i>		compressus	obliquely obovate	yellow-ferrugineous, ferrugineous	0.45	0.25
	v. <i>Nakaii</i>		"	"	"	"	"
<i>Septati</i>	<i>J. alatus</i>		alatus	obovate, broadly obovate	ferrugineous	0.55	0.25
	<i>J. bombonzanensis</i>		"	obovate	yellow-ferrugineous	0.7	0.35
	<i>J. diastrophanthus</i>		"	"	ferrugineous	0.6	0.25
	<i>J. Fauriensis</i>		"	scobiform, elliptical, oblong	"	1.0	0.4
	v. <i>iwatensis</i>		"	"	"	1.0	0.4
	<i>J. kamschatcensis</i>		"	scobiform, oblong	ferrugineous	1.0	0.3
	<i>J. Krameri</i>		"	obovate	pale ferrugineous	0.5	0.2
	<i>J. lampocarpus</i>		?	?	?	?	?
	<i>J. Mertensianus</i>		?	?	?	?	?
	<i>J. nikkoensis</i>		alatus	elliptically oblong	ochreous-yellow	0.65	0.25
	v. <i>minor</i>		"	"	"	"	"
	<i>J. oligocephalus</i>		"	obliquely-obovate or -oblong	ferrugineous	0.6	0.3
	<i>J. papillosus</i>		"	obovate, narrowly obovate	"	0.65	0.25
	<i>J. prismatocarpus</i> v. <i>Leschenaultii</i> subvar. <i>pluritubulosus</i>		"	obovate	yolk-yellow	0.6	0.25
	subvar. <i>unittubulosus</i>		"	"	brown-ferrugineous	0.6	0.3
	subvar. <i>viviparus</i>		"	oblong	ferrugineous	0.65	0.3
	<i>J. togakusiensis</i>		"	elliptical	"	0.5	0.25
	<i>J. Tokubuchii</i>		?	?	?	?	?
	<i>J. yakeisidakensis</i>		triglumis	obovate	yellow-brown	0.6	0.3

No. 2. *Junci Genuini, Alpini and Graminifolii.*

Sub- genera	Characters	Types of reticulation	Shapes	Colours	Sizes	
	Species				length	width
<i>Genuini</i>	<i>J. beringensis</i>	beringensis	scobiform, oblong-elliptical	pale ferrugineous	1.0	0.4
	<i>J. brachyspathus</i>	triglumis	obliquely obovate, obovate	ferrugineous	0.6	0.3
	<i>J. curvatus</i>	"	elliptical	"	0.6	0.3
	<i>J. decipiens</i>	decipiens	obliquely-obovate or -elliptical	"	0.5	0.25
	v. <i>gracilis</i>	"	"	"	0.6	0.3
	v. <i>glomeratus</i>	"	"	"	"	"
	<i>J. Fauriei</i>	Fauriei	broadly-obovate, obovate	gray- ferrugineous	0.8	0.45
	<i>J. filiformis</i>	decipiens	elliptical	ferrugineous	0.6	0.3
	<i>J. Haenkei</i>	"	broadly obovate, obliquely obovate	gray- ferrugineous	0.9	0.5
	<i>J. setchuensis</i> v. <i>effusoides</i>	Fauriei	obliquely obovate	ferrugineous	0.6	0.3
	v. <i>compactus</i>	"	"	"	"	"
<i>Alpini</i>	<i>J. castaneus</i>	triglumis	scobiform, oblong	yolk-yellow	1.0	0.33
	v. <i>koreanus</i>	?	?	?	?	?
	<i>J. luzuliformis</i> v. <i>Potanii</i>	?	?	?	?	?
	<i>J. Maximowiczii</i>	triglumis	scobiform, oblong	ferrugineous	0.7	0.25
	<i>J. modicus</i>	?	"	brown	0.8	0.3
	<i>J. stygius</i>	?	"	ferrugineous	1.3	0.6
	<i>J. triglumis</i>	triglumis	"	yolk-yellow	1.0	0.3
<i>Graminifolii</i>	<i>J. prominens</i>	?	obliquely obovate	yellow- ferrugineous	0.6	0.2

No. 3. *Luzula Pterodes*, *Anthelaea* and *Gymnodes*.

Sub-gen.	Characters Species	Forms of reticulation	Positions of caruncle and ratios of the caruncle to seed	Shapes	Colours	Sizes	
						length	width
<i>Pterodes</i>	<i>L. formosana</i>	?	chalazal, 1:2	?	?	?	?
	<i>L. Jimboi</i>	?	?	?	?	?	?
	<i>L. japonica</i>	?	chalazal, 1:1	broadly-ovovate or -elliptical	black-brown	1.0	0.8
	<i>L. plumosa</i>	irregular	chalazal, 1:1	elliptical	ferrugineous, red-brown	1.6	1.2
	v. <i>brachycarpa</i>	"	"	"	"	1.0	0.7
	v. <i>sphaerosperma</i>	"	chalazal, $\frac{1}{2}$:1	sphaerical	black-brown	1.3	1.3
	<i>L. rostrata</i>	"	chalazal, 1:1	broadly-ovovate or -elliptical	ferrugineous, red-brown	1.5	1.2
	<i>L. rufescens</i>	"	"	broadly-ovate or -elliptical	"	1.3	1.0
	v. <i>macrocarpa</i>	?	"	"	"	1.3	1.0
<i>Anthelaea</i>	<i>L. chinensis</i>	?	?	?	?	?	?
	<i>L. effusa</i>	irregularly hexagonal	absent	broadly-ovate or -elliptical	ferrugineous, chestnut-coloured	1.4	0.9
	<i>L. parviflora</i> v. <i>melanocarpa</i>	?	"	?	?	?	?
	<i>L. Wahlenbergii</i>	irregularly hexagonal	"	elliptical	chestnut-coloured	1.3	0.8
<i>Gymnodes</i>	<i>L. capitata</i>	"	micropylar, $\frac{1}{2}$:1	broadly ovate	pale black	1.2	0.8
	<i>L. arcuata</i> v. <i>unalaschkensis</i>	?	?	?	?	?	?
	<i>L. Kjellmanniana</i>	?	?	?	?	?	?
	<i>L. multiflora</i>	hexagonal	micropylar, $\frac{1}{2}$:1	broadly ovate, sphaerical	ferrugineous	1.3	1.0
	v. <i>lutescens</i>	"	"	"	"	1.2	0.8
	<i>L. oligantha</i>	"	micropylar, very small	elliptical	"	1.0	0.6
	<i>L. pallescens</i>	"	"	"	"	"	"
	<i>L. taiwaniana</i>	"	micropylar, $\frac{1}{4}$:1	"	black-brown, chestnut-coloured	1.3	0.8

IV. Enumeration of the Japanese Juncaceae, with Synoptical Keys.

In their "Enumeratio Plantarum in Japonia sponte crescentium II. (1879)" FRANCHET and SAVATIER, who first studied the Japanese *Juncaceae*, described three species, *Juncus alatus*, *J. Krameri* and *J. papillosus*. FR. BUCHENAU is the next botanist who greatly contributed to our knowledge of the rush-family. In his "Monographia Juncacearum (1890) and Juncaceae (1906)," the eminent authority described many new species and varieties, such as, *Juncus Maximowiczii*, *J. curvatus*, *J. diastrophanthus*, *J. Fauriensis*, *J. compressus* var. *gracilimus*, *J. effusus* var. *decipiens*, *Luzula japonica*, *L. rostrata* and *L. rufescens* var. *macrocarpa*, and classified all the species so far known from all parts of the world.

The Japanese species were enumerated by MATSUMURA in his "Index Plantarum Japonicarum II. (1905)," by MIYABE and KUDÔ in their "Materials for a flora of Hokkaido II. (1915) and Flora of Hokkaido and Saghalen III. (1932)," by MAKINO and NEMOTO in their "Flora of Japan, ed. 1. (1925) and ed. 2. (1931)," by NAKAI in his "Flora Koreana II. (1911) and many other papers" and by other botanists in their different works.

In the following pages, there is given an enumeration of all the species so far known from Japan together with synoptical keys. The species are arranged after the system of BUCHENAU, but in some cases some deviations in the arrangements are made in considering the anatomy of carpels and characters of seeds.

Juncaceae.

- | | |
|--------------------------------|------------------------|
| {Ovules many in an ovary | <i>Juncus</i> (p. 172) |
| {Ovules 3 in an ovary..... | <i>Luzula</i> (p. 192) |

1) *Juncus* LINNAEUS, Gen. Pl. ed. 1. (1737) p. 104.

Key to the Subgenera.

- | | | |
|---|--|--------------------------------------|
| 1 | {Flowers with prophylls | 2 |
| | {Flowers without prophylls | 3 |
| 2 | {Stem scapiform, with scaly lower leaves. Inflorescence pseudo-lateral, the undermost bract being stem-like and usually surpassing the inflorescence in length | (2) <i>Junci Genuini</i> (p. 175) |
| | {Stem not scapiform, with cauline leaves which are gramineous, plane or somewhat canaliculate. Inflorescence terminal, compound or decompound | (1) <i>Junci Poiophylli</i> (p. 173) |

- 3 { Lamina gramineous, plane or canaliculate (5) *Junci Graminifolii* (p. 192)
 { Lamina not gramineous, but terete, somewhat compressed or angusti-filiform 4
- 4 { Lamina terete or laterally compressed. Inflorescence compound or decompound. Stamens
 shorter than tepals..... (3) *Junci Septati* (p. 180)
 { Lamina angusti-filiform, terete. Inflorescence simple or somewhat compound. Stamens
 usually exerted from tepals (4) *Junci Alpini* (p. 189)

(1) Subgen. *Junci Poiophylli* BUCHENAU, Monogr. Juncac. (1890) p. 169.

Key to the Species.

- 1 { Annual 2
 { Perennial 3
- 2 { Tepals a little longer than the capsule *J. bufonius* (p. 173)
 { Tepals much longer than the capsule..... *J. leptocladus* (p. 174)
- 3 { Tepals obtuse. Capsule much longer than the tepals
 { *J. compressus* var. *gracillimus* (p. 174)
 { Tepals acute. Capsule shorter than the tepals 4
- 4 { Auricle very large and oblong. Capsule elliptical, more or less shorter than the
 tepals..... *J. tenuis* (p. 175)
 { Auricle medial and ovate. Capsule ovate-sphaerical, obtuse, remarkably shorter than
 the tepals..... *J. tenuis* var. *Nakaii* (p. 175)

1. ***Juncus bufonius*** LINNAEUS (Fig. 2.-1, 2, 3; Fig. 7.-1, 2, 3; Fig. 17.-1, 2), Spec. Pl. ed. 1. (1753) p. 328; E. MEYER, Syn. Juncor. (1822) p. 39; FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 99; BUCHENAU, Monogr. Juncac. (1890) p. 174 et Juncac. (1906) p. 105; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 183; KOMAROV, Fl. Manschur. I. (1901) p. 425; FORBES & HEMSLEY in Journ. Linn. Soc. XXXVI. (1903) p. 162; KOIDZUMI, Pl. Sachal. Nakahara. (1910) p. 32; NAKAI, Fl. Koreana, II. (1911) p. 266; TAKEDA, Fl. Shikotan (1914) p. 491; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 489; MORI, Enum. Pl. Corea (1922) p. 82; HULTEN, Fl. Kamtschatk. I. (1927) p. 218; KOMAROV, Fl. Pen. Kamtschat. I. (1927) p. 276; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1289 et ed. 2. (1931) p. 1523; YAMAZUTA, List of Manchur. Pl. (1930) p. 55; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 296.

J. ranarius NEES in Linnaea, XX. (1847) p. 243; KOMAROV, l. c. (1927) p. 276.

Nom. Jap. Hime-kôgaizekisyô.

Hab. Saghalien: Basse (G. NAKAHARA, 1906); Alexandrovsk (OKADA, 1923); Palkhata (eodem). Yezo: Abasiri, prov. Kitami (K. MIYABE, 1884); Mt. Apoi, prov. Hidaka (T. NAKAI, 1928). Honsyu: Tokyo, prov. Musasi (J. MATSUMURA, 1880); ibidem (T. MAKINO, 1893); Morioka, prov. Rikutyû (G. TOBA). Sikoku: Tokusima, prov. Awa (J. NIKAI, 1915). Corea: Genzan, Kankyô-nandô (T. NAKAI, 1909); Tinkô, ibidem (eodem); Somui, ibidem (eodem); Yuzyô, Kankyô-hokudô (eodem); Zyun'an, Heian-nandô (H. IMAI, no. 55, 1912); Kurei (T. NAKAI, 1913).

Distr. The Kuriles, Kyusyu, Manchuria, Amur, Ussuri, Kamtchatka, Siberia, Himalaya, Central Asia, Europe, North and South America and Australia.

2. ***Juncus compressus*** JACQUIN, Enum, Stirp. Pler. Vindobon. (1762) p. 60, 235.

var. ***gracillimus*** BUCHENAU (Fig. 8.-1; Fig. 14.-5, 6), Juncac. (1906) p. 112; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 183; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 489; MORI, Enum. Pl. Corea (1922) p. 82; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1289 et ed. 2. (1931) p. 1523; YAMAZUTA, List of Manchur. Pl. (1930) p. 55; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 297.

J. compressus (non JACQUIN) KOMAROV, Fl. Manshur. I. (1901) p. 427; NAKAI, Fl. Koreana, II. (1911) p. 266.

Nom. Jap. Mizu-i, Doro-i.

Hab. Yezo: Bentenzima, prov. Nemuro (K. MIYABE, 1884); Muroran, prov. Iburi (J. MATSUMURA, 1899).

Honsyu: Tokyo, prov. Musasi (J. MATSUMURA, 1879); ibidem (T. MAKINO, 1899). Kyusyu: Izuhara, prov. Tusima (K. HIRATA, 1902); Keti, ibidem (N. OKADA, 1902): Corea: Orige, Kankyô-nandô (T. NAKAI, 1909); Eikô, ibidem (eodem); Ins. Kyomon (eodem, no. 10829, 1923); Ins. Soto-rarô (eodem, no. 10830, 1928); Ins. Quel-paert (TAQUET, 1911). Formosa: ? (T. SÔMA).

Distr. Saghalien, Manchuria and China.

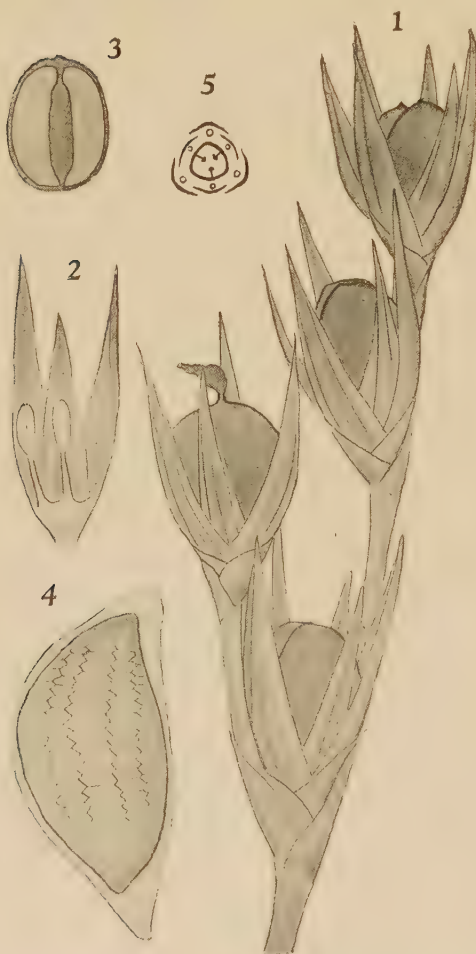


Fig. 17. *Juncus tenuis* var. *Nakaii* SATAKE. 1. a portion of inflorescence; 2. tepals with 2 stamens; 3. a carpel; 4. a seed showing tegmen; 5. diagram of a flower. 1-3 = \times ca. 8; 4 = \times 120.

3. ***Juncus leptocladus*** HAYATA, Icon. Pl. Formos. VI. (1916) p. 100; SASAKI, List of Pl. Formos. (1928) p. 102 et Catal. Govern. Herbar. (1930) p.

122; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1524.

Nom. Jap. Arisan-kusai (HAYATA).

Hab. Formosa: Mt. Arisan (U. FAURIE, no. 147, 1914).

An endemic plant.

4. **Juncus tenuis** WILLDENOW (Fig. 9.-1; Fig. 14.-3, 4) in LINNAEUS, Spec. pl. II. (1799) p. 214; E. MEYER, Syn. Juncor. (1822) p. 44; BUCHENAU, Monogr. Juncac. (1890) p. 193 et Juncac. (1906) p. 115; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 185; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1293 et ed. 2. (1931) p. 1526; MIYABE & KUDÔ in Trans. Nat. Hist. Sapporo, V. (1915) p. 39 et Fl. Hokkaido and Saghal. III. (1932) p. 297.

J. bicornis MICHX. Fl. bor.-amer. I. (1803) p. 191.

Nom. Jap. Kusa-i, Sirane-i.

Hab. Yezo: Tomosiri, prov. Nemuro (D. HOSI, 1911); Tomakomai, prov. Iburi (S. AKIYAMA, 1928); Numanohata, prov. Iburi (Y. SATAKE, 1931). Honsyu: Tokyo, prov. Musasi (T. MAKINO, 1893); Kasegazaka, prov. Nagato (J. NIKAI, 1918); Tutiya-mura, prov. Harima (K. TSUKIYAMA, 1918); Mt. Hieizan, prov. Yamasiro (N. UI, 1927); Prov. Sinano (Y. OGAWA, 1928).

Distr. Asia, North and South America, Europe and Australia.

var. **Nakaii** SATAKE, var. nov. (Fig. 17).

J. compressus var. *gracillimus* (non BUCHENAU) NAKAI in sched. Herb. Imp. Univ. Tokyo.

Rami inflorescentiae erecti. Auriculae mediae ovatae. Fructus sphaero-ovatus, apice obtusus, tepalis conspicue brevior.

Nom. Jap. Tati-kusai.

Hab. Honsyu: Toyonaka, prov. Settu (N. UI, no. 56, 1927—type in Herb. Imp. Univ. Tokyo).

An endemic plant.

(2) Subgen. *Junci Genuini* BUCHENAU, Monogr. Juncac. (1890) p. 169.

Key to the Species.

1	{ Capsule trilocular.....	2
	{ Capsule triseptate.....	4
2	{ Inflorescence loose.....	3
	{ Inflorescence compact.....	<i>J. decipiens</i> var. <i>glomeratus</i> (p. 178)
3	{ Plant rigid and somewhat aquatic. Seed nearly obtuse at the chalazal end.....	
	{.....	<i>J. decipiens</i> (p. 177)
	{ Plant slender and mountain-species. Seed nearly cuspidate at the chalazal end.....	
	{.....	<i>J. decipiens</i> var. <i>gracilis</i> (p. 178)
4	{ Seed scobiform.....	<i>J. beringensis</i> (p. 176)
	{ Seed conformed.....	5
5	{ Stamens 3.....	6
	{ Stamens 6.....	7
6	{ Inflorescence loose.....	<i>J. setchuensis</i> var. <i>effusoides</i> (p. 180)
	{ Inflorescence compact.....	<i>J. setchuensis</i> var. <i>compactus</i> (p. 180)
7	{ Flowers stramineous or viridescent.....	8
	{ Flowers chestnut-coloured.....	10

- 8 { Capsule sphaerically ovate and obtuse *J. filiformis* (p. 179)
 { Capsule trigonously ovate and mucronate..... 9
- 9 { Outer tepals a little longer than the inner ones. The undermost bract of the inflorescence about 3-5 cm. long..... *J. brachyspathus* (p. 176)
 { Outer tepals very much longer than the inner ones. The undermost bract of the inflorescence about 20-40 cm. long *J. curvatus* (p. 176)
- 10 { Anther twice as long as the filament. Epidermis in the outer surface of a carpel consists of 1 layer of lignified and thickened cells *J. Fauriei* (p. 178)
 { Anther equal in length to the filament. Epidermis in the outer surface of a carpel looks like consisting of 2 layers of lignified and thickened cells, owing to the thickening and lignifying of cell-walls of the cells lying close to the epidermis
 *J. Haenkei* (p. 179)

5. ***Juncus beringensis*** BUCHENAU (Fig. 1.-2; Fig. 6.-7; Fig. 13.-1, 2), Monogr. Juncac. (1890) p. 226 et Juncac. (1906) p. 129; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 183; KUDÔ, Fl. Paramushir (1922) p. 87; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1289 et ed. 2. (1931) p. 1523; HULTEN, Fl. Kamtschatk. I. (1927) p. 217; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 278; NAKAI, Rep. Veg. Daisetzuan (1930) p. 59; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 298.

J. Fauriei LÉVEILLÉ & VANIOT in Bull. Soc. Bot. Fr. LI. (1904) p. 292, pro pte.

Nom. Jap. Miyama-i, Tateyama-i.

Hab. Yezo: Mt. Tokatidake, prov. Isikari (G. KOIDZUMI, 1916); Mt. Daisetzuan, prov. Isikari (H. KOIDZUMI); ibidem (T. NAKAI, 1928); ibidem (Y. SATAKE, 1931). Honsyu: Mt. Komagadake, prov. Sinano (J. MATSUMURA, 1880); ibidem (K. WATANABE, 1894); ibidem (J. NIKAI, 1912); Mt. Tateyama, prov. Ettyû (J. MATSUMURA, 1884); ibidem (K. KIMURA, 1928); Mt. Siroma, prov. Sinano (Y. YABE, 1902); ibidem (S. KODAMA, 1908); ibidem (M. HONDA, 1928).

Distr. The Kuriles, Kamtschatka, the Aleutian Islands and the Bering Sea regions.

6. ***Juncus brachyspathus*** MAXIMOWICZ, Prim. Fl. Amur. (1859) p. 293; BUCHENAU, Monogr. Juncac. (1890) p. 225 et Juncac. (1906) p. 128; KOMAROV, Fl. Manschur. I. (1901) p. 426; NAKAI, Fl. Koreana, II. (1911) p. 266; MORI, Enum. Pl. Corea (1922) p. 82; YAMAZUTA, List of Manchur. Pl. (1930) p. 55.

J. filiformis var. *brachyspathus* REGEL, Tent. Fl. Ussur. (1861), p. 157.

Nom. Jap. Kôrai-i.

Hab. Corea: Unczen-gan, northern Corea (KOMAROV, no. 349, 1897).

Distr. Manchuria, Amur, Ussuri and East Siberia.

7. ***Juncus curvatus*** BUCHENAU (Fig. 4.-4, 5; Fig. 7.-4, 5, 6), Juncac. (1906) p. 128; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 183; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 490; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1289 et ed. 2. (1931) p. 1523; NAKAI, Rep. Veg. Daisetzuan (1930) p. 60; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 298.

J. filiformis var. *curvatus* KUDÔ, Contr. Fl. N. Saghal. (1923) p. 26; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 219, 243, 265 et 293.

Nom. Jap. Ezo-hosoi, Risiri-i.

Hab. Yezo: Nemuro, prov. Nemuro (K. MIYABE, 1884); Zyôzankei, prov. Isikari (J. MATSUMURA, no. 11, 1899); Mt. Yûbarisan, prov. Isikari (G. KOIDZUMI, 1916); Mt. Daisetzuan, prov. Isikari (T. NAKAI, 1928). Honsyu: Mt. Hakusan, prov. Kaga (J. MATSUMURA, 1881); Mt. Iwakisan, prov. Mutu (eodem, 1884); ibidem (N. KINASHI, no. 86, 1901); Mt. Hakkôda, prov. Mutu (eodem, no. 85); Mt. Myôkô, prov. Etigo (S. MATSUDA, 1894); Mt. Komagadake, prov. Etigo (B. HAYATA, 1903); Ozenuma, prov. Iwasiro (eodem); Mt. Azuma, prov. Iwasiro (G. KOIDZUMI, 1909); Mt. Gassan, prov. Uzen (eodem); Mt. Ontake, prov. Sinano (J. NIKAI, 1911); Mt. Tateyama, prov. Ettyû (K. KIMURA, no. 280732, 1928); ibidem (T. OTAYA, 1930); Mt. Sirouma, prov. Sinano (M. HONDA, 1928); Mt. Iwatesan, prov. Rikutyû (Y. FUKUDA, 1929); Hatimanhira, prov. Rikutyû (S. MURAMATSU, 1931).

Distr. The Kuriles and Saghalien.

An endemic plant.

8. ***Juncus decipiens*** NAKAI (Fig. 9-3), Rep. Veg. Kamikôti (1928) p. 35; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 299.

J. effusus var. *decipiens* BUCHENAU, Monogr. Juncac. (1890) p. 229 et Juncac. (1906) p. 136; MATSUMURA, Ind. Pl. Jap. II (1905) p. 183; KOMAROV, Fl. Manschur. I. (1901) p. 426; YAMAZUTA, List of Manchur. Pl. (1930) p. 55; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1290 et ed. 2. (1931) p. 1523.

Nom. Jap. I, I-gusa, Tôsin-sô.

Hab. Honsyu: Mt. Hakusan, prov. Kaga (J. MATSUMURA, 1881); Mt. Amagi, prov. Izu (eodem, 1883); Nanzyô, prov. Sinano (eodem, 1884); Mt. Aomori-dake, prov. Mutu (eodem); Ins. Miyakezima, prov. Izu (ÔKUBO, 1887); Tenzingawa, prov. Suô (J. NIKAI, 1892); Takamatu-muru, prov. Bittyû (eodem, 1902); Aomori, prov. Mutu (N. KINASHI, 1902); Hodogaya, prov. Sagami (K. KIMURA, 1927); Kata, prov. Kii (S. SAKAGUCHI, 1930); Itikawa, prov. Simôsa (Y. SATAKE, 1930). Sikoku: Matusima-mura, prov. Awa (J. NIKAI, 1913). Kyusyu: Hyakkanseki, prov. Higo (J. MATSUMURA, 1879); Kokubunzi, prov. Iki (K. OHKI, 1925). Corea: Northern Corea (KOMAROV, no. 348, 1897); Mt. Kongôzan, Kôgendô (T. UCHIYAMA, 1902); Keizyô (N. OKADA, 1909); Sorai (R. G. MILLS, 1921); Ins. Uturyô (T. NAKAI, 1917). Formosa: Taipe (T. MAKINO, 1896); Kelung (U. FAURIE, no. 800, 1903); Mt. Morrison (NAGASAWA, 1905); ibidem (T. KAWAKAMI et U. MORI, 1906); Kelung (B. HAYATA, 1916); Suizan (eodem); Mt. Ritôzan (E. MATUDA, 1918); Kirenkei-Asahi (eodem, 1919).

Distr. Yezo and Manchuria.

form. ***utilis*** (MAKINO)

J. effusus var. *decipiens* from. *utilis* MAKINO in MAKINO & NEMOTO, Fl. Jap. (1925) p. 1290 et ed. 2. (1931) p. 1524.

Nom. Jap. Kohige.

Cultivated in Japan.

form. ***spiralis*** (MAKINO)

J. effusus var. *decipiens* form. *spiralis* MAKINO in Journ. Jap. Bot. VII. (1931) p. 27.

Nom. Jap. Rasen-i (MAKINO).

Cultivated in Japan.

var. ***gracilis*** NAKAI (Fig. 15.-5, 6), Rep. Veg. Daisetzuzan (1930) p. 60; MIYABE & KUDÔ, Fl. Kokkaido and Saghal. III. (1932) p. 299.

J. effusus var. *decipiens* form. *gracilis* BUCHENAU ex MATSUMURA, Ind. Pl. Jap. II. (1905) p. 184; MAKINO & NEMOTO, l. c. (1925) p. 1290 et ed. 2. (1931) p. 1524.

J. effusus var. *decipiens* (non BUCHENAU) KOIDZUMI, Pl. Sachal. Nakahara. (1910) p. 32.

Nom. Jap. Hime-i.

Hab. Saghalien: Chipisani (G. NAKAHARA, 1906); Sakaihana (T. SAWADA, 1923); Toyohara (eodem). Yezo: Zyôzankei, prov. Isikari (J. MATSUMURA, 1899); Mt. Daisetzuzan, prov. Isikari (T. NAKAI, 1928); Mt. Apoi, prov. Hidaka (eodem); Hakodate, prov. Osima (K. TSUKAMOTO, 1926). Honsyu: Tokiwano, prov. Mutu (J. MATSUMURA, 1880); Mt. Ibukiyama, prov. Ômi (eodem, 1881); Mt. Togakusi, prov. Sinano (eodem, 1884); Simizu, prov. Izu (ÔKUBO, 1886); Mt. Myôkô, prov. Etigo (S. MATSUDA, 1894); Mt. Komagadake, prov. Etigo (B. HAYATA, 1903); Mt. Osoreyama, prov. Mutu (N. KINASHI, 1910); Mt. Ontake, prov. Sinano (G. KOIDZUMI, 1910); Mt. Hakkôda, prov. Mutu (eodem, 1914); Mt. Bandai, prov. Iwasiro (S. HATTORI, 1925); Akaiyazi, prov. Iwasiro (eodem, 1926); Kamikôti, prov. Sinano (T. NAKAI, 1927). Sikoku: Mt. Kôtuzan, prov. Awa (leg? 1907).

Distr. The Kuriles.

An endemic plant.

var. ***glomeratus*** (MAKINO) SATAKE, comb. nov.

J. effusus var. *decipiens* form. *glomeratus* MAKINO in Bot. Mag. Tokyo, XII. (1898) p. 163; MAKINO & NEMOTO, l. c. (1925) p. 1290 et (1931) p. 1523.

J. effusus var. *compactus* (non LEJEUN. et COURT.) NAKAI, Rep. Veg. Chiisan (1915) p. 25 et Rep. Veg. Apoi (1930) p. 76; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 299.

J. effusus var. *decipiens* (non BUCHENAU) MIYABE & MIYAKE, Fl. Saghal. (1915) p. 491.

Nom. Jap. Tama-i.

Hab. Yezo: Hakodate, prov. Osima (J. MATSUMURA, 1899); Mt. Apoi, prov. Hidaka (T. NAKAI, 1928). Honsyu: Nerima, prov. Musasi (J. MATSUMURA, 1880). Corea: Goryudô (T. UCHIYAMA, 1900); Eitoho, Keikidô (eodem, 1902); Kogan, Heiandô (H. IMAI, 1909); Kaugkai (R. G. MILLS); Ins. Quelpaert (T. NAKAI, 1917).

Distr. Saghalien and the Kuriles.

An endemic plant.

9. ***Juncus Fauriei*** LÉVEILLÉ & VANIOT (Fig. 4.-1, 2, 3; Fig. 8.-2; Fig. 14.-1, 2) in Bull. Soc. Bot. Fr. LI. (1904) p. 292; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 300.

J. balticus var. *japonicus* BUCHENAU, Monogr. Juncac. (1890) p. 215 et Juncac. (1906) p.

145; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 183; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 492; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1289 et ed. 2. (1931) p. 1522.

J. glaucus var. *yokoscensis* FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 97.

J. balticus (non WILLDENOW) FRANCHET & SAVATIER, l. c. p. 533.

Nom. Jap. Hira-i, Inu-j, Nezi-i.

Hab. Kuriles: Ins. Sikotan (J. OHWI, 1931—in Herb. Imp. Univ. Kyoto). Yezo: Yûbutu, prov. Iburi (K. MIYABE, 1884); Hakodate, prov. Osima (J. MATSUMURA, 1899); Numanohata, prov. Iburi (Y. SATAKE, 1931). Honsyu: Aomori, prov. Mutu (J. MATSUMURA, 1884); ibidem (N. KINASHI, 1899 et 1909); Mt. Togakusi, prov. Sinano (J. MATSUMURA, 1884); Prov. Kazusa (J. MATSUMURA, 1902); Kaihuho, prov. Etigo (YAMAMOTO, 1907); Hiraiso, prov. Hitati (I. ANDO, 1910); Arayahama, prov. Ugo (G. KOIDZUMU, 1914); Narutô, prov. Kazusa (T. NAKAI, 1920). Kyusyu: Mt. Asosan, prov. Higo (YABE); ibidem (Y. NABESIMA, 1926).

Distr. Saghalien.

An endemic plant.

10. ***Juncus filiformis*** LINNAEUS (Fig. 7.-7, 8, 9), Spec. Pl. ed. 1. (1753) p. 326; E. MEYER, Syn. Juncor. (1822) p. 17; BUCHENAU, Monogr. Juncac. (1890) p. 224 et Juncac. (1906) p. 127; KOMAROV, Fl. Manschur. I. (1901) p. 426; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 490; HULTEN, Fl. Kamtschatk. I. (1927) p. 220; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 277; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1524; YAMAZUTA, List of Manchur. Pl. (1930) p. 55; MIYABE & KUKÔ, Fl. Hokkaido and Saghal. III. (1932) p. 297.

J. effusus var. *decipiens* (non BUCHENAU) KUDÔ, Fl. Paramushir (1922) p. 87.

Nom. Jap. Karahuto-hosoi (MIYABE & KUDÔ).

Distr. Kuriles, Saghalien, Manchuria, Amur, Kamtschatka, Ussuri, Siberia, and arctic zones of Europe and North America.

11. ***Juncus Haenkei*** E. MEYER (Fig. 8.-4; Fig. 15.-3, 4), Syn. Juncor. (1922) p. 10; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 278; SATAKE in Bot. Mag. Tokyo, XLVI. (1932) p. 185.

J. balticus var. *Haenkei* BUCHENAU, Monogr. Juncac. (1890) p. 215 et Juncac. (1906) p. 145; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 182; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1289 et ed. 2. (1931) p. 1522; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 300; TATEWAKI, Phytogeogr. Middle Kuriles (1933) p. 219, 243, 264, 274, 292.

J. balticus (non WILLD.) MIYABE, Fl. Kuril. (1890) p. 266.

J. balticus (non WILLD.) SAMUELSSON in HULTEN, Fl. Kamtschatk. I. (1927) p. 216, pro pte.

J. arcticus (non WILLD.) KOIDZUMI in Bot. Mag. Tokyo, XV. (1901) p. 205.

J. arcticus var. *sitchensis* ENGELMANN in Trans. St. Louis Acad. II. (1866) p. 445.

Nom. Jap. Hama-i, O-inui.

Hab. Kuriles: Ins. Simusyu (K. YENDO, 1903). Saghalien: Siska (T. SAWADA, 1923); Oha (OKADA, 1923). Yezo: Tomakomai, prov. Iburi (J. MATSUMURA, 1899).

Distr. Korea, Manchuria, Kamtchatka, the Aleutian Islands, Unalaska and Sitcha.

12. ***Juncus setchuensis*** BUCHENAU in ENGLER, Bot. Jahrb. XXXVI. Beibl. 82 (1905) p. 17.

var. ***effusoides*** BUCHENAU (Fig. 9.-2), l. c. et Juncac. (1906) p. 142; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 185.

J. pauciflorus (non R. BROWN) MAKINO in Bot. Mag. Tokyo, XII. (1898) p. 163; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1525.

J. effusus var. *gracilis* NAKAI, Rep. Veg. Quelpaert (1914) p. 29.

J. effusus var. *decipiens* (non BUCHENAU) NAKAI in sched. Herb. Imp. Univ. Tokyo.

Nom. Jap. Hoso-i.

Hab. Honsyu: Tokyo, prov. Musasi (J. MATSUMURA, 1880); Mt. Kasugayama, prov. Yamato (eodem, 1883); Aomori, prov. Mutu (N. KINASHI, 1909); Ayase, prov. Musasi (S. HATTORI, 1921); Kasukabe, prov. Musasi (K. KIMURA, 1927); Kata, prov. Kii (S. SAKAGUCHI, 1930). Kyusyu: Tomioka, prov. Higo (K. MAYEBARA, 1930). Korea: Zensyû, Zenra-nandô (T. MORI, no. 63, 1912); Ins. Quelpaert (T. NAKAI, no. 286 et 899, 1913); ibidem (T. ISIDOYA, no. 160, 1912).

Distr. China.

var. ***compactus*** SATAKE, var. nov.

J. effusus var. *compactus* (non LEJEUN. et COURT.) NAKAI in sched. Herb. Imp. Univ. Tokyo.

Inflorescentia compacta multis (50-60) floribus.

Nom. Jap. Tama-hosoi (nov.).

Hab. Korea: Kyûrei (T. NAKAI, no. 548, 1913).

An endemic plant.

(3) Subgen. *Junci Septati* BUCHENAU, Monogr. Juncac. (1890) p. 169.

Key to the Species.

- | | | | |
|---|---|---|---|
| 1 | { | Seed scobiform..... | 2 |
| | { | Seed conformed | 5 |
| 2 | { | Inflorescence with few heads. Outer tepals lanceolate, acute, and inner ones ovate, obtuse..... | 3 |
| | { | Inflorescence with many heads. Outer tepals ovate-lanceolate, obtuse, and inner ones lanceolate, acute | <i>J. Tokubuchii</i> (p. 188) |
| 3 | { | Stamens 6 | <i>J. kamschatcensis</i> (p. 184) |
| | { | Stamens 3 | 4 |
| 4 | { | Stem 18-40 cm. high. Lamina 5-15 cm. long, very much shorter than the inflorescence. Anther linear, equal in length to the filament | <i>J. Fauriensis</i> (p. 184) |
| | { | Stem 50-40 cm. high. Lamina 20-30 cm. long, often equal in length to or a little shorter than the inflorescence. Anther ovate, one half as long as the filament | <i>J. Fauriensis</i> var. <i>iwatensis</i> (p. 183) |

- 5 { Stem mostly compressed, ancipital. Lamina broad, remarkably compressed, poly-
(rarely uni-) tubulose, usually imperfectly septate 6
Stem not ancipital, but terete or somewhat terete. Lamina terete or somewhat com-
pressed, uni-tubulose, perfectly septate 15
- 6 { Rhizome horizontal, with elongated internodes..... *J. oligocephalus* (p. 186)
Rhizome horizontal or somewhat erect, with short or shortest internodes 7
- 7 { Stem remarkably winged 8
Stem a little or not at all winged 10
- 8 { Inflorescence with many heads. Auricle very small..... 9
Inflorescence with 1-2-3 heads. Auricle large, white, ovate.....
..... *J. yakeisidakensis* (p. 189)
- 9 { Stamens 6. Head hemi-sphaerical. Capsule conically prismatic..... *J. alatus* (p. 181)
Stamens 3. Head sphaerical. Capsule long prismatic *J. togakusensis* (p. 188)
- 10 { Capsule as long as the tepals or rather longer than the latter, triangularly conical or
triangularly prismatic *J. prismatocarpus* var. *Leschenaultii*..... 11
Capsule remarkably longer than the tepals, narrowly triangularly prismatic, with an
attenuate apex 13
- 11 { Auricle large, obtuse. Lamina terete or subcompressed, uni-tubulose, perfectly septate
..... subvar. *unitubulosus* (p. 187)
Auricle small. Lamina compressed, poly-tubulose, imperfectly septate 12
- 12 { Head not viviparous. Stem erect..... subvar. *pluritubulosus* (p. 187)
Head viviparous. Stem procumbent at the base..... subvar. *viviparus* (p. 188)
- 13 { Plant large. Stem winged, with broad leaves. Head not viviparous
..... *J. diastrophanthus* (p. 182)
Plant very small. Stem subterete with narrow and short leaves. Head viviparous.....
..... *J. hombonzanensis* (p. 182)
- 14 { Inflorescence simple, terminal, with 1 head *J. Mertensianus* (p. 185)
Inflorescence compound or decompound 15
- 15 { Stamens 6. Auricle large, obtuse 16
Stamens 3. Auricle small 17
- 16 { Tepals equally long. Anther linear, equal in length to the filament.....
..... *J. lampocarpus* (p. 184)
Inner tepals somewhat longer than the outer ones. Anther ovate, very much shorter
than the filament *J. Krameri* (p. 184)
- 17 { Inflorescence large, about 25 cm. long and broad, divergent. Head with 2-3 flowers.
Seed ferrugineous *J. papillosus* (p. 186)
Inflorescence small, about 3-5 cm. long and broad, not divergent. Head with 3-6
flowers. Seed ochreous-yellow..... 18
- 18 { Plant 15-30 cm. high. Lamina completely septate *J. nikkoensis* (p. 185)
Plant 7-15 cm. high. Lamina incompletely septate, very much papillate.....
..... *J. nikkoensis* var. *minor* (p. 185)

13. **Juncus alatus** FRANCHET & SAVATIER (Fig. 1.-3; Fig. 6.-3), Enum. Pl. Jap. II. (1879) p. 98, 534; BUCHENAU, Monogr. Juncac. (1890) p. 304 et Juncac. (1906) p. 180; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 182; NAKAI, Fl. Koreana, II. (1911) p. 267, Rep.

Veg. Quelpaert (1914) p. 29 et Rep. Veg. Chiisan (1915) p. 25; MORI, Enum. Pl. Corea (1922) p. 82; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1288 et ed. 2. (1931) p. 1522.

Nom. Jap. Hanabi-zekisyô.

Hab. Honsyu: Tokiwano, prov. Mutu (J. MATSUMURA, 1880); Tokyo, prov. Musasi (eodem); Araizyuku, prov. Musasi (eodem); Mt. Kasugayama, prov. Yamato (eodem, 1883); Kawanakazima, prov. Sinano (eodem, 1884); Mt. Togakusi, prov. Sinano (eodem); ibidem (S. MATSUDA, 1893); Kaminohara, prov. Izumi (eodem, 1896); Mt. Bukô, prov. Musasi (eodem, 1901); Itinomiya, prov. Kazusa (J. MATSUMURA, 1903); Narutô, prov. Kazusa (T. NAKAI, 1922); Mt. Zaô, prov. Uzen (S. AKIYAMA, 1929); Noborito, prov. Musasi (K. KIMURA, 1929); circ. Zimmuzi, prov. Sagami (Y. MOMIYAMA, 1929); Mt. Tukuba, prov. Hitati (K. OHKI, 1930); Hatimanyama, prov. Suruga (D. SIMIZU, 1930). Sikoku: Misyû-mura, prov. Awa (S. MATSUDA, 1888); Hôgasyô-dôzan, prov. Tosa (S. YANO, 1890). Kyusyu: Mt. Yatate-yama, prov. Tusima (Y. YABE, 1901). Corea: Ins. Quelpaert (T. TAQUET, no. 6181, 1912); ibidem (T. NAKAI, no. 860, 213 et 1431, 1913); Mt. Chii-san (eodem, 1913); Ins.

Soto-rarô (eodem, 1928).

Distr. China.

14. ***Juncus bombonzanensis*** SATAKE, sp. nov. (Fig. 18 et Pl. I.)

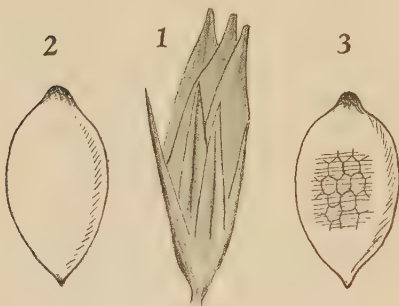


Fig. 18. *Juncus bombonzanensis* SATAKE. 1. a flower with a mature capsule; 2-3. seeds showing tegmen. 1 = \times ca. 8; 2, 3 = \times 37.5.

Planta pusilla gracilis. Caules subteretes, 5-15 cm. alti. Folia caulina breviora, 1-3 cm. longa, 0.5-1 mm. lata, incomplete septata. Inflorescentia subcomposita, 3-6 capitulis. Capitula multiflora viviparentia. Flos ca. 4-5 mm. longus, tepalis angustis aequilongis. Stamina 3, tepala $\frac{1}{3}$ in longitudine aequantia; antherae filamentis multo breviores. Fructus anguste prismaticus, tepalis duplo longiores. Semina 0.7 mm. longa, obovata vel lato-elliptica, apiculata, flavo-ferruginea, regulariter hexagonaliter reticulata.

Nom. Jap. Hosoba-no-komotizekisyô (nov.)

Hab. Formosa: Mt. Bombonzan (E. MATUDA, 1918—type in Herb. Imp. Univ. Tokyo). An endemic plant.

15. ***Juncus diastrophanthus*** BUCHENAU, Monogr. Juncac. (1890) p. 309 et Juncac. (1906) p. 182; FORBES & HEMSLEY in Journ. Linn. Soc. Bot. XXXVI. (1903) p. 163; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 183; NAKAI, Rep. Veg. Quelpaert (1914) p. 29 et Rep. Veg. Chii-san (1915) p. 25; MORI, Enum. Pl. Corea (1922) p. 82; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1290 et ed. 2. (1931) p. 1523; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 302.

Nom. Jap. Hiroha-no-kôgaizekisyô.

Hab. Yezo: Toyohira, prov. Isikari (J. MATSUMURA, 1899); Mt. Apoi, prov. Hidaka (T. NAKAI, 1928). Honsyu: Mt. Gassan, prov. Uzen (J. MATSUMURA); Tokiwano, prov.

Mutu (J. MATSUMURA); Hondôzi, prov. Uzen (eodem, 1886); Simizu, prov. Izu (eodem); Sino-mura, prov. Tanba (TAKEUTI, 1912); Yamada-mura, prov. Nagato (J. NIKAI, 1917); Tutiya-mura, prov. Harima (K. TUKIYAMA, 1918); Prov. Ettyû (T. OTAYA); Ugosakai, prov. Ugo (S. MURAMATSU, 1931); Koseki-mura, prov. Iwasiro (N. IMAI, 1931). Sikoku: Mt. Wariisayama, prov. Iyo (J. MATSUMURA, 1888). Kyusyu: Buzenbo (N. OKADA, 1900). Korea: Nangen, Zenra-hokudô (T. MORI, 1912); Sinsyû, Keisyô-nandô (eodem); Mt. Chii-san (T. NAKAI, 1913); Ins. Quelpaert (T. TAQUET, no. 1961, 1908 et 5190, 1911).

Distr. China.

16. ***Juncus Fauriensis*** BUCHENAU (Fig. 6.-8) in Notzibl. Kon. Bot. Gart. Berl. III. (1901) p. 127 et Juncac. (1906) p. 159; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 184; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1290 et ed. 2. (1931) p. 1524; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 280; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 301; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 219.

J. Fauriensis var. *typicus* BUCHENAU, l. c. (1906) p. 159.

Nom. Jap. Hosô-kôgaizekisyô.

Hab. Kuriles: Ins. Sikotan et Ins. Kuna-siri (J. OHWI, 1931—in Herb. Imp. Univ. Kyoto). Yezo: Tomakomai, prov. Iburi (J. MATSUMURA); Tusikari, prov. Isikari (G. KOIDZUMI). Honsyu: Mt. Azuma, prov. Iwasiro (G. KOIDZUMI, 1911 et 1912); Morioka, prov. Rikutyû (G. TOBA, 1926); Kosiromori, prov. Ugo (S. MURAMATSU, 1931); Mt. Hakkôda, prov. Mutu (S. MURAI, 1930).

Distr. Saghalien and Kamtschatka.

var. ***iwatensis*** SATAKE, var. nov. (Fig. 19)

Caules erecti subteretes, 40–50 cm. alti, ca. 1–2 mm. in diametro. Lamina teres unitubulosa, 10–20 cm. longa. Inflorescentia terminalis, 5–10 capitulis pauce (2–3) floribus. Tepala aequilonga apice obtusa. Stamina 3, tepalis paulo breviora; antherae globosae, filamenta $\frac{1}{4}$ in longitudine aequantes. Fructus castaneus, tepalis duplo longior, triseptatus. Semina scobiformia, 1 mm. longa, ferruginea, irregulariter hexagonaliter reticulata.

Nom. Jap. Iwate-hosokôgaizekisyô (nov.).

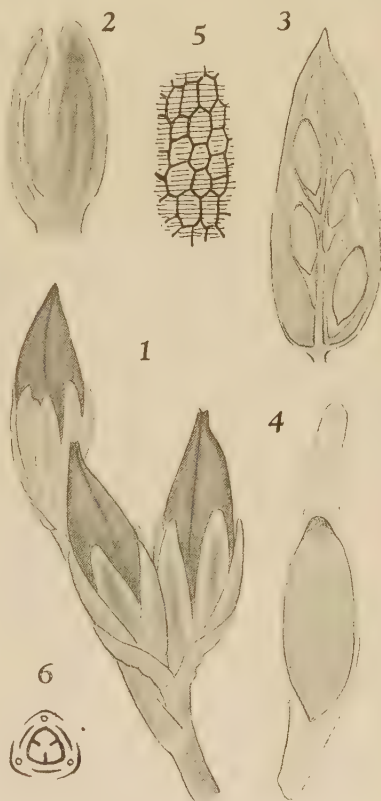


Fig. 19. *Juncus Fauriensis* var. *iwatensis* SATAKE. 1. a head; 2. tepals with a stamen; 3. a carpel with 4 scobiform seeds; 4. a scobiform seed; 5. tegmen; 6. diagram of a flower. 1 = $\times 7.5$; 2, 3 = \times ca. 11; 4 = $\times 27$; 5 = $\times 82.5$.

Hab. Honsyu: Kakkonda, prov. Rikutyû (S. MURAI, 1930—type in Herb. Imp. Univ. Tokyo).

An endemic plant.

17. **Juncus kamschatcensis** KUDÔ (Fig. 8.-3; Fig. 12.-7, 8), Fl. Paramushir (1922) p. 88; MIYBE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 301; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 219, 243, 264.

J. Fauriensis BUCHENAU var. *kamschatcensis* BUCHENAU, Juncac. (1906) p. 159; KOIDZUMI in MATSUMURA, Icon. Koishikaw. II. (1914) p. 75, Pl. 122; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1290 et ed. 2. (1931) p. 1524; HULTEN, Fl. Kamtchatk. I. (1927) p. 219.

Nom. Jap. Miyama-hosokôgaizekisyô (KOIDZUMI), Tisima-hosokôgaizekisyô (MIYABE).

Hab. Honsyu: Mt. Gassan, prov. Uzen (G. KOIDZUMI, 1909); Mt. Zaô, prov. Rikuzen (A. KIMURA, 1929); Mt. Iwatesan, prov. Rikutyû (S. MURAI, 1930); Mt. Moriyosi, prov. Ugo (S. MURAMATSU, 1931); Mt. Kuraisidake, prov. Rikuzen (S. MURAI, 1931).

Distr. The Kuriles, Yezo and Kamtchatka.

18. **Juncus Kramerii** FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 99, 534; BUCHENAU, Monogr. Juncac. (1890) p. 383 et Juncac. (1906) p. 220; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 184; NAKAI, Fl. Koreana, II. (1911) p. 268, Rep. Veg. Quelpaert (1914) p. 29 et Rep. Veg. Apoi (1930) p. 76; MORI, Enum. Pl. Corea (1922) p. 82; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1524; YAMAZUTA, List of Manchur. Pl. (1930) p. 55; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 304.

J. articulatus (non LINNAEUS) MIYABE, Fl. Kuril. (1890) p. 266.

Nom. Jap. Tati-kôgaizekisyô.

Hab. Yezo: Zenibako, prov. Isikari (J. MATSUMURA, 1899); Tomakomai, prov. Iburi (eodem); Asahigawa, prov. Isikari (G. KOIDZUMI, 1916); Hakodate, prov. Osima (K. TSUKAMOTO, 1926); Zenibako, prov. Isikari (S. AKIYAMA, 1928). Honsyu: Itinomiya, prov. Kazusa (J. MATSUMURA, 1899); Aomori, prov. Mutu (N. KINASHI, no. 88, 1899); Nakayama-tôge, prov. Rikutyû (S. AKIYAMA, 1928); Itugun, prov. Kii (S. SAKAGUCHI, 1930); Tamura, prov. Ugo (S. MURAMATSU, 1931). Kyusyu: Izuhara, prov. Tusima (Y. YABE, 1911). Ryukyu: Ins. Okinawa (J. MATSUMURA); Kunzyan, Ins. Okinawa (TASIRO, 1887). Corea: Senhatu, Kôgendô (T. UCHIYAMA, 1902); Mosan, Kankyô-hokudô (T. NAKAI, no. 1647, 1914); Ins. Quelpaert (T. TAQUET, no. 9193, 1911); ibidem (T. MORI, no. 28 et 136, 1911); ibidem (T. ISIDOYA, no. 107, 1912).

Distr. The Kuriles and Manchuria.

19. **Juncus lampocarpus** EHRHART, Calam. etc. n. 126 (ca. 1791); E. MEYER, Syn. Juncor. (1822) p. 23; BUCHENAU, Monogr. Juncac. (1890) p. 376 et Juncac. (1906) p. 217; HULTEN, Fl. Kamtchatk. I. (1927) p. 221; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1524; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 304.

J. articulatus LINNAEUS, Spec. Pl. ed. 1. (1753) p. 327 et ed. 2. (1762) p. 465.

Nom. Jap. Karahuto-hanabizekisyô (MIYABE).

Distr. The Kuriles, Saghalien, Kamtchatka, Siberia, China, Europe and North America.

20. **Juncus Mertensianus** BONGARD in Mem. St. Petersburg. ser. 6. II. (1833) p. 167; ENGELMANN in Trans. St. Louis Acad. II. (1868) p. 479; BUCHENAU, Monogr. Juncac. (1890) p. 272 et Juncac. (1906) p. 201; KURTZ in ENGLER's Bot. Jahrb. XIX. (1895) p. 412; ABRAMS, III. Fl. Pacific St. I. (1923) p. 363, f. 888; NAKAI, Rep. Veg. Daisetsuzan (1930) p. 60, 74; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 303; SATAKE in Bot. Mag. Tokyo, XLVI. (1932) p. 185.

J. ensifolius (non WIKSTR.) KOIDZUMI in Bot. Mag. Tokyo, XXXI. (1917) p. 262; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1290 et ed. 2. (1931) p. 1524.

Nom. Jap. Ezo-mikurizekisyô (NAKAI), Kumoma-mikurizekisyô (MIYABE).

Hab. Yezo: Mt. Tyûbetudake, prov. Isikari (H. KOIDZUMI, 1917); Mt. Daisetsuzan, prov. Isikari (T. NAKAI, 1928).

Distr. The Aleutian Islands, Alaska and Mountain-regions of North America.

21. **Juncus nikkoensis** SATAKE, sp. nov. (Fig. 20 et Pl. II.)

Caules erecti teretes, 15–30 cm. alti. Folia caulina 3–4, 5–10 cm. longa, folia basilaria brevissima. Lamina unitubulosa complete septata, auriculis minoribus. Inflorescentia composita, 3–5 cm. longa, 2–4 cm. lata, cum 3–13 capitulis. Capitula 3–6 florata. Flores ca. 4–5 mm. longi, tepalis internis distincte longioribus. Stamina 3, tepalis externis aequilongia; antherae ovato-oblongae filamentis pluries breviores. Fructus tepalum conspicue superans, ovato-prismaticus, rostratus. Semina elliptica vel oblonga, ca. 0.65 mm. longa, luteo-ochracea, hexagonaliter reticulata.

Nom. Jap. Nikkô-kôgaizekisyô (nov.)

Hab. Honsyu: Yumoto, Nikko, prov. Simotuke (Y. MOMIYAMA, 1931—type in Herb. Imp. Univ. Tokyo); Sirasugahara, circ. Yumoto, ibidem (H. ITOH, 1931); Odasirohara, Nikko, ibidem (eodem); Mt. Mitutôge, prov. Kai (Y. MOMIYAMA, no. 343, 1930).

An endemic plant.

This new species resembles *J. leptospermus* BUCHENAU, but is clearly distinguishable from the latter in having not so tall and rigid stem and in having elliptical and ochreous seeds which are larger than those of the other.

var. **minor** SATAKE, var. nov.

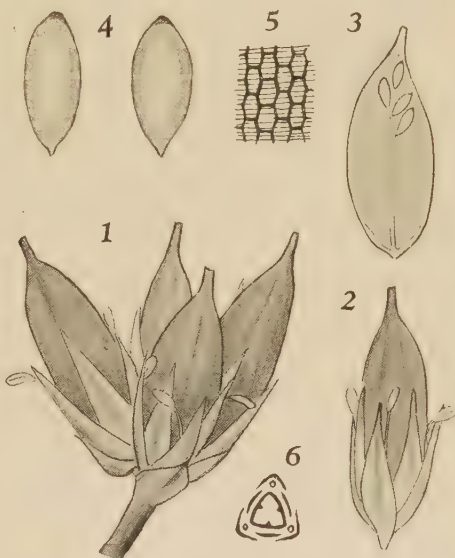


Fig. 20. *Juncus nikkoensis* SATAKE. 1. a head; 2. a flower with a mature capsule; 3. a carpel; 4. seeds; 5. tegmen; 6. diagram of a flower. 1, 2, 3 = \times ca. 8; 4 = \times 30; 5 = \times 75.

Planta viridis. Caules 7–15 cm. alti. Lamina unitubulosa, incomplete septata, valde papillosissima.

Nom. Jap. Hime-nikkôkôgaizekisyô (nov.)

Hab. Honsyu: Mt. Gandoyama, prov. Rikuzen (S. MURAI, 1931—type in Herb. Imp. Univ. Tokyo).

An endemic plant.

22. ***Juncus oligocephalus*** SATAKE & OHWI in Act. Phytotax. Geobot. II. (1933) p. 104.

J. xiphioides (non MEYER) BUCHENAU, Monogr. Juncac. (1890) p. 306, quoad pl. ex Japonia et Auct. Jap.

Nom. Jap. Mikuri-zekisyô, Kurô-mikurizekisyô, Ô-mikurizekisyô (MIYABE et KUDÔ).

Hab. Kuriles: Ins. Kunasiri (J. OHWI, 1931, no. 998,—type in Herb. Imp. Univ. Kyoto). Yezo: Sapporo, prov. Isikari (K. MIYABE); Zyôzankei, prov. Isikari (J. MATSUMURA, 1899). Honsyu: Mt. Hakusan, prov. Kaga (J. MATSUMURA, 1881); Ozenuma, prov. Iwasiro (Y. KOBAYASI, 1929).

An endemic plant.

23. ***Juncus papillosus*** FRANCHET & SAVATIER (Fig. 6.-2), Enum. Pl. Jap. II. (1879) p. 98, 533; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 185; MIYABE & KUDÔ in Trans. Nat. Hist. Soc. Sapporo, V. (1915) p. 39 et Fl. Hokkaido and Saghal. III. (1932) p. 303; MORI, Enum. Pl. Corea (1922) p. 83; NAKAI, Rep. Veg. Apoi (1930) p. 76; YAMAZUTA, List of Manchur. Pl. (1930) p. 55; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1292 et ed. 2. (1931) p. 1525.

J. niponensis BUCHENAU, Monogr. Juncac. (1890) p. 340 et Juncac. (1906) p. 198; MATSUMURA, l. c. p. 184; KOMAROV, Fl. Manschur. I. (1901) p. 429; NAKAI, Fl. Koreana, II. (1911) p. 268.

J. umbellifer LÉVEILLÉ & VANIOT in Bull. Soc. Bot. Fr. LI. (1904) p. 292.

Nom. Jap. Hosoba-no-kôgaizekisyô, Ao-kôgaizekisyô.

Hab. Yezo: Hakodate, prov. Osima (J. MATSUMURA, 1899); circ. Akan-ko, prov. Kusiô (S. AKIYAMA, 1928). Honsyu: Nikko, prov. Simotuke (J. MATSUMURA, 1877); Mt. Ontake, prov. Sinano (eodem, 1880); Wada-mura, prov. Musasi (eodem); Sinoda, prov. Izumi (eodem, 1896); Aomori, prov. Mutu (N. KINASHI, 1899, 1905, 1907 et 1911); Takamatumura, prov. Bittyû (J. NIKAI, 1902); Prov. Sinano (M. TAHARA, 1911); Hanno, prov. Musasi (K. KIMURA, 1926); Mt. Sinodayama, prov. Izumi (S. SAKAGUCHI, 1927); Higasimurayama, prov. Musasi (K. KIMURA, 1927); Susugadani, prov. Sagami (Y. MOMIYAMA, 1928); Mt. Ogasayama, prov. Totomi (D. SIMIZU, 1929); Kisi-mura, prov. Kii (S. SAKAGUCHI, 1929); ibidem (Y. OGAWA, 1929); Ippekiko, prov. Izu (K. KIMURA, 1930); Nisiogikubo, prov. Musasi (F. MAEKAWA, 1931); Maeda-mura, prov. Ugo (S. MURAMATSU, 1931); Koseki-mura, prov. Iwasiro (N. IMAI, no. 65 et 66, 1931). Sikoku: Nyûta-mura, prov. Awa (J. NIKAI, no. 2388, 1913). Kyusyu: Mt. Nisi-kirisimayama, prov. Satuma (S. YAJIMA, 1910); Nisize, prov. Higo (K. MAYEBARA, no. 354, 1929). Corea: Goryudô (T. UCHIYAMA, 1910); Eitoho, Keikidô (eodem, 1902); Mt. Nankanzan, Keikidô (eodem); Mt. Kongôzan,

Kogendô (T. UCHIYAMA); Suigen, Keikidô (S. RI, 1912); ibidem (S. UEKI, 1912); Mt. Hotaizan (T. NAKAI, 1914); Yosyû, Keikidô (eodem, 1915); Ins. Quelpaert (T. TAQUET, 1910 et 1911).

Distr. Manchuria, Amur and China.

24. **Juncus prismatocarpus** R. BROWN, Prodr. fl. N. Holl. (1810) p. 259.

var. **Leschenaultii** BUCHENAU in ENGLER, Bot. Jahrb. VI. (1885) p. 205, Monogr. Juncac. (1890) p. 311 et Juncac. (1906) p. 180.

J. Leschenaultii GAY, ex FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 98, 533.

subvar. **pluritubulosus** BUCHENAU (Fig. 1.-1; Fig. 13.-1, 2), l. c. (1890) p. 311 et (1906) p. 181; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 185; NAKAI, Rep. Veg. Quelpaert (1914) p. 29; MORI, Enum. Pl. Corea (1922) p. 83; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1292 et ed. 2. (1931) p. 1525; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 302; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 220.

J. prismatocarpus (R. BROWN) MATSUMURA et HAYATA, Enum. Pl. Formos. (1906) p. 451.

Nom. Jap. Kôgai-zekisyô, Hira-kôgaizekisyô.

Hab. Yezo: Sapporo, prov. Isikari (J. MATSUMURA). Honsyu: Hamanosiba, prov. Kazusa (J. MATSUMURA, 1880); Suwa, prov. Sinano (eodem); Mt. Hakusan, prov. Kaga (eodem, 1881); Mt. Kasugayama, prov. Yamato (eodem, 1883); Tyôzyagahara, prov. Izu (eodem); Simizu-tôge, prov. Etigo (eodem, 1886); Ins. Miyakezima, prov. Izu (eodem, 1887); Dôkanyama, prov. Musasi (leg? 1889); Harada-mura, prov. Tôtômi (Y. MASUDA, 1891); Nobe-mura, prov. Tôtômi (M. HISAMATSU, 1893); Mama, prov. Simôsa (S. MATSUDA, 1894); Mt. Myôkô, prov. Etigo (eodem, 1894); Kaminohara, prov. Izumi (eodem, 1896); Aomori, prov. Mutu (N. KINASHI, 1910); Prov. Inaba (Y. IKOMA, 1914); Tubakigô-higasibun-mura, prov. Nagato (J. NIKAI, 1917); Koseki-mura, prov. Iwaki (N. IMAI, 1930); Kônodai, prov. Simôsa (Y. SATAKE, 1930); Mt. Taiheizan, prov. Ugo (S. MURAMATSU, 1931); Mituseki-mura, prov. Ugo (eodem); Minami-karuizawa, prov. Sinano (H. HARA, 1929). Kyusyu: Gônoura, prov. Iki (K. OHKI, 1925); Ins. Amami-Ôsima, prov. Ôsumi (S. YAJIMA, 1912); Ins. Yakusima, prov. Ôsumi (Y. YOSHII). Ryukyu: Nago (NAKA, 1907). Formosa: Taipéh (S. YANO, 1897); Kameyama (B. HAYATA, 1916); Heirinji (eodem); Suisya (eodem); Oiwake, Musya (E. MATUDA, 1919). Corea: Kôryô (T. MORI, 1912); Kyûrei (T. NAKAI, 1913); Ins. Quelpaert (eodem); ibidem (T. TAQUET, 1911, 1912); Mt. Hallaisan, Ins. Quelpaert (U. FAURIE, no. 2245, 1907).

Distr. Sikoku, India and Ceylon.

subvar. **unitubulosus** BUCHENAU, l. c. (1890) p. 311 et (1906) p. 181; MATSUMURA, l. c. (1905) p. 185; KOMAROV, Fl. Manshur. I. (1901) p. 428; NAKAI, Fl. Korean. II. (1911) p. 267 et Rep. Veg. Quelpaert (1914) p. 29; MIYABE & MIYAKE, Fl. Sagahl. (1915) p. 429; MAKINO & NEMOTO, l. c. (1925) p. 1292 et (1931) p. 1526; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 281; MIYABE & KUDÔ, l. c. (1932) p. 302.

J. Wallichianus LAHARPE, Monogr. Jonc. (1827) p. 139; NAKAI, Rep. Veg. Apoi (1930) p. 76.

J. Leschenaultii var. *radicans* FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 533.

J. prismatocarpus var. *Leschenaultii* subvar. *unitubulosus* form. *radicans* BUCHENAU, apud MAKINO & NEMOTO, Fl. Jap. (1925) p. 1292 et ed. 2. (1931) p. 1526.

Nom. Jap. Hai-kôgaizekisyô, Hari-kôgaizekisyô.

Hab. Yezo: Hakodate, prov. Osima (K. TSUKAMOTO, 1926). Honsyu: Aizu, prov. Iwasiro (J. MATSUMURA, 1879); Nobe-mura, prov. Tôtômi, (M. HISAMATSU, 1893); Sinoda, prov. Izumi (S. MATSUDA, 1896); Mikita, prov. Izumi (eodem); Uenohara, prov. Izumi (eodem); Koseki-mura, prov. Iwaki (N. IMAI, no. 1, 6 et 9, 1930); Mt. Hakkôzan, prov. Hitati (T. SAITO, no. 18 et 26, 1930); Nikko, prov. Simotuke (Y. MOMIYAMA, 1931); Toga, prov. Ugo (S. MURAMATSU, 1931). Sikoku: Ikeda, prov. Sanuki (HIRAMA, 1910). Kyusyu: Mt. Hikosan, prov. Buzen (HAMADA, 1905); Mt. Iwatakeyama, prov. Buzen (J. MATSUMURA, 1882). Ryukyu: Nagu (S. TANAKA, 1891). Formosa: Tôentyô (T. KAWAKAMI et SASAKI, 1910); ibidem (SÔMA, 1916). Corea: northern Corea (KOMAROV, no. 353, 1897); Ninzitu, Zenra-hokudô (T. MORI, no. 38, 1912); Syabaku, Ins. Quelpaert (T. NAKAI, 1913); Singisyû (eodem, 1915); Sin'ansyû (eodem).

Distr. Saghalien, Manchuria, Amur, Ussuri and China.

subvar. **viviparus** KOIDZUMI in Bot. Mag. Tokyo, XXIX. (1915) p. 309; MAKINO & NEMOTO, l. c. (1925) p. 1293 et (1931) p. (1526).

Nom. Jap. Komoti-zekisyô (KOIDZUMI).

Hab. Honsyu: Wada-mura, prov. Musasi (J. MATSUMURA, 1880); Tani-mura, prov. Yamasiro (eodem, 1888); Ôuti-mura, prov. Suô (J. NIKAI, 1892); Kaminohara, prov. Izumi (S. MATSUDA, 1896); Hukebi, prov. Izumi (eodem); Sanbôzi, prov. Musasi (eodem, 1901); Aomori, prov. Mutu (N. KINASHI, 1903); Mt. Ontake, prov. Sinano (G. KOIDZUMI, 1910); Okayama (H. MORI, 1914); Yamada-mura, prov. Nagato (J. NIKAI, 1921); Zinmuzi, prov. Sagami (Y. MOMIYAMA, 1929); Ogikubo, prov. Musasi (K. OHKI, 1930); Kônodai, prov. Simôsa (Y. SATAKE, 1930). Kyusyu: Mt. Nisidake, prov. Hyûga (J. MATSUMURA, 1882); Simozima, prov. Tusima (Y. YABE, 1901). Ryukyu: Ins. Yaeyama (S. YAJIMA, 1912).

An endemic plant.

25. **Juncus togakusiensis** LÉVEILLÉ in FEDDE, Repert. Spec. Nov. X. (1911-12) p. 352; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1293 et ed. 2. (1931) p. 1526.

Nom. Jap. Tama-kôgaizekisyô.

Hab. Honsyu: Aizu, prov. Iwasiro (J. MATSUMURA, 1879); Wakamatu, prov. Iwasiro (eodem); Mt. Azuma, prov. Iwasiro (G. KOIDZUMI); Ônada, prov. Hida (M. HONDA, 1925).

An endemic plant.

26. **Juncus Tokubuchii** MIYABE & KUDÔ in Trans. Nat. Hist. Soc. Sapporo, VIII. (1921) p. 2 et Fl. Hokkaido and Saghal. III. (1932) p. 301; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1293 et ed. 2. (1931) p. 1526.

Nom. Jap. Horomui-kôgai (MIYABE & KUDÔ).

Hab. Yezo: Horomui, prov. Isikari (TOKUBUCHI, 1894—type in Herb. Hokkaido Imp. Univ.).

An endemic plant.

27. ***Juncus yakeisidakensis* SATAKE**, sp. nov. (Fig. 21 et Pl. III.)

Rhizoma brevissimum. Caules erecti graciles, valde ancipiti-compressi, alati, 12–20 cm. alti, 1–1.5 mm. lati. Folia 4–9 cm. longa, 1–2 mm. lata; lamina pluritubulosa cum auriculis magnis albis obtusis. Inflorescentia terminalis subcomposita cum 2–3 capitulis; bractea infima subfrondosa plerumque inflorescentia brevior. Capitula 2–6 florata. Flos 4 mm. longus distincte pedunculatus; tepala lanceolata vel lineari-lanceolata, acutissima, aequilonga vel externa paulo longiora. Stamina 3, tepalis breviora; antherae oblongae filamentis breviores. Fructus stramineo-fuscus, tepalis aequilongus vel ia paulo superans, ovato-prismaticus, rostratus, unilocularis. Semina obovata, ca. 0.6 mm. longa, ferruginea, hexagonaliter reticulata.

Nom. Jap. Miyama-zekisyô.

Hab. Honsyu: Mt. Yakeisidake, prov. Rikutyû (H. IWA-
BUCHI, 1931—type in Herb. Imp.
Univ. Tokyo).

An endemic plant.

This new species is near to
J. alatus, *J. prismatocarpus* and *J.*
diastrophanthus, but is distinguish-

able from them in having a fewer heads with a flower on a distinct peduncle and in having the leaves with large and white auricles.



Fig. 21. *Juncus yakeisidakensis* SATAKE. 1. an inflorescence with 2 heads; 2. a flower with a mature capsule; 3. tepals with a stamen; 4. a carpel; 5. a seed; 6. tegmen; 7. diagram of a flower. 1= $\times 1.5$; 2, 3, 4= \times ca. 8; 5= \times ca. 38; 6= $\times 75$.

(4) Subgen. *Junci Alpini* BUCHENAU, Monogr. Juncac. (1890) p. 170.

Key to the Species.

- | | | | |
|---|---|--|---|
| 1 | { | Inflorescence compound, with 2–5 or more heads | 2 |
| | | Inflorescence simple, with a single head | 3 |

- 2 { Stamens equal in length to or a little shorter than the tepals. Capsule remarkably longer than the tepals *J. castaneus* (p. 190)
 { Stamens one half as long as the tepals. Capsule nearly equal in length to the tepals...
 *J. castaneus* var. *koreanus* (p. 190)
- 3 { Leaves situated mostly towards the base of the stem. Bracts and tepals chestnut-coloured..... *J. triglumis* (p. 192)
 { Leaves situated along the whole length of the stem. Bracts and tepals stramineous, brown or greenish white 4
- 4 { Leaves erect, usually much shorter than the stem. Seeds stramineous, 1.3-1.5 mm. long, and somewhat scobiform *J. stygius* (p. 191)
 { Leaves slender, divergent, nearly equal in length to or longer than the stem. Seeds 0.8 mm. long, ferrugineous, scobiform 5
- 5 { Capsule shining chestnut-coloured, retuse at the apex, nearly equal in length to the tepals *J. modicus* (p. 191)
 { Capsule brown, attenuate at the apex, remarkably longer than the tepals..... 6
- 6 { Tepals narrowly linear, equal in length. Stamens exserted from the tepals
 *J. Maximowiczii* (p. 191)
 { Tepals lanceolate; the inner ones longer than the outer. Stamens nearly equal in length to the tepals *J. luzuliformis* var. *Potaminii* (p. 190)

28. ***Juncus castaneus*** SMITH (Fig. 1.-4; Fig. 4.-9, 10, 11; Fig. 6.-6), Fl. brit. I. (1800) p. 383; E. MEYER, Syn. Juncor. (1822) p. 57; KURTZ in ENGLER, Bot. Jahrb. XIX. (1895) p. 412, 476; BUCHENAU, Monogr. Juncac. (1890) p. 403 et Juncac. (1906) p. 233; KOIDZUMI, Pl. Yokoy. (1911) p. 205; KUDÔ, Fl. Paramushir (1922) p. 89; HULTEN, Fl. Kamtschatk. I. (1927) p. 219; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 282; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 305; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 304.

J. castaneus var. *fuscus* HOOKER, Fl. bor.-Amer. II. (1840) p. 192; NAKAI, Rep. Veg. Daisetuzan (1930) p. 60.

Nom. Jap. Kuro-kôgaizekisyô (NAKAI).

Hab. Kuriles: Ins. Paramusiro (T. ÔHASI, 1932—in Herb. Imp. Univ. Kyoto). Yezo: Mt. Daisetuzan, prov. Isikari (T. NAKAI, 1928); ibidem (Y. SATAKE, 1931) Korea: Nanseturei (Goto, 1917).

Distr. Kamtschatka, Ochotsk, Siberia, Mongolia, China, Europe and North America.
 var. ***koreanus*** OHWI in Bot. Mag. Tokyo, XLV. (1931) p. 189.

Nom. Jap. Tyôsen-kurokôgaizekishyô.

Hab. Korea: Shin-hun-don (J. OHWI, 1930—type in Herb. Imp. Univ. Kyoto).
 An endemic plant.

29. ***Juncus luzuliformis*** FRANCHET in Nouv. Arch. Mus. d'Histoire Nat. X. (1887) p. 99.

var. ***Potaminii*** BUCHENAU ex DIELS in ENGLER, Bot. Jahrb. XXXVII. (1905) Beibl. 82, p. 15, 17; BUCHENAU, Juncac. (1906) p. 228, f. 105; KOIDZUMI in Bot. Mag. Tokyo,

XXX. (1916) p. 329; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1525; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 305.

J. Potaninii BUCHENAU, Monogr. Juncac. (1890) p. 349; DIELS in ENGLER, Bot. Jahrb. XXIX. (1900) p. 238.

Nom. Jap. Ezo-itoi.

Hab. Yezo: Mt. Kamuimetokunupri (H. KOIDZUMI, 1915). Core: Mt. Kanbôhû, Kankyô-hokudô (J. OHWI, 1932—in Herb. Imp. Univ. Kyoto).

Distr. China.

New to the Flora of Core.

30. **Juncus Maximowiczii** BUCHENAU (Fig. 4.-6, 7, 8; Fig. 6.-4; Fig. 12.-3, 4), Monogr. Juncac. (1890) p. 394 et Juncac. (1906) p. 226, f. 104; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 184; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1525.

J. cupreus LÉVEILLÉ & VANIOT in Bull. Soc. Bot. Fr. LI. (1904) p. 292.

Nom. Jap. Ito-i.

Hab. Honsyu: Mt. Komagadake, prov. Sinano (J. MATSUMURA, 1880); Mt. Huzi, prov. Suruga (eodem, 1881); Mt. Togakusi, prov. Sinano (eodem, 1884); Nikko, prov. Simotuke (eodem, 1885); Mt. Yatugadake, prov. Sinano (B. HAYATA, 1905); Senzyôgahara, Nikkô, prov. Simotuke (T. NAKAI, 1929); Mt. Komagadake, prov. Kai (Y. SATAKE, 1932). Core: Tôkadô (J. OHWI, 1930—in Herb. Imp. Univ. Kyoto); Mt. Kanbôhû, Kankyô-hokudô (J. OHWI, 1932—in Herb. Imp. Univ. Kyoto).

An endemic plant.

New to the Flora of Core.

31. **Juncus modicus** N. E. BROWN in Journ. Linn. Soc. XXXVI. (1903) p. 165; BUCHENAU, Juncac. (1906) p. 231; HAYATA, Mater. Fl. Formos. (1911) p. 370; SASAKI, List of Pl. Formos. (1928) p. 102 et Catal. Govern. Herb. (1930) p. 122; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1291 et ed. 2. (1931) p. 1525.

J. Maximowiczii (non BUCHENAU) HAYATA, Fl. Mont. Formos. (1908) p. 229.

Nom. Jap. Niitaka-itoi (HAYATA).

Hab. Formosa: Mt. Morrison (G. NAKAHARA, 1905); Mt. Nôkôzan (E. MATUDA, 1919).

Distr. China.

32. **Juncus stygius** LINNAEUS, Syst. nat. II. ed. 10 (1759) p. 987; E. MEYER, Syn. Juncor. (1822) p. 55; BUCHENAU, Monogr. Juncac. (1890) p. 392 et Juncac. (1906) p. 225; HULTEN, Fl. Kamtchatk. IV. (1930) p. 244; OHWI in Bot. Mag. Tokyo, XLV. (1931) p. 188; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 306.

Nom. Jap. Yati-i (OHWI), Tisima-itoi (MIYABE & KUDÔ).

Hab. Kuriles: Ins. Kunasiri (J. OHWI, no. 956, 1931). Core: Teitek, Kankyô-hokudô (J. OHWI, no. 2619, 1930).

Distr. Kamtchatka, Siberia, Europe, Scandinavia and North America.

33. **Juncus triglumis** LINNAEUS (Fig. 2.-7, 8, 9; Fig. 6.-5), Spec. Pl. (1753) p. 328; E. MEYER, Syn. Juncor. (1822) p. 56; BUCHENAU, Monogr. Juncac. (1890) p. 388 et Juncac. (1906) p. 224; KURTZ in ENGLER, Bot. Jahrb. XIX. (1895) p. 477; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 186; KUDÔ, Fl. Paramushir (1922) p. 88; HULTEN, Fl. Kamtchatk. I. (1927) p. 223; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1293 et ed. 2. (1931) p. 1526; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 305.

Nom. Jap. Takane-i, Sirouma-zekisyô.

Hab. Kuriles: Ins. Simusyu (K. KOJIMA, 1932—in Herb. Imp. Univ. Kyoto). Yezo: Mt. Daisetuzan, prov. Isikari (Y. SATAKE, 1931). Honsyu: Mt. Sirouma, prov. Sinano (Y. YABE, 1902); ibidem (G. KOIDZUMI, 1917); ibidem (M. HONDA, 1928). Corea: Mt. Tosyô-zan, Kankyô-hokuhô (K. SAITO, 1932—in Herb. Imp. Univ. Kyoto).

Distr. Kamtchatka, Ochotsk, Siberia, Himalaya, Tibet, Europe and North America.
New to the Flora of Corea.

(5) Subgen. *Junci Graminifolii* BUCHENAU, Monogr. Juncac. (1890) p. 170.

34. **Juncus prominens** MIYABE & KUDÔ (Fig. 1.-5; Fig. 3; Fig. 9.-4; Fig. 11.-1, 2) in Trans. Nat. Hist. Soc. Sapporo, V. (1915) p. 40; KUDÔ, Fl. Paramushir (1922) p. 89; HULTEN, Fl. Kamtchatk. I. (1927) p. 222; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1293 et ed. 2. (1931) p. 1526; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 306; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 220.

J. falcatus var. *prominens* BUCHENAU, Juncac. (1906) p. 247, f. 116; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 184.

Nom. Jap. Sekisyô-i, Ezo-no-mikurizekisyô (NAKAI).

Hab. Yezo: Tomakomai, prov. Iburi (J. MATSUMURA, 1899); ibidem (S. AKIYAMA, 1930); Mt. Apoi, prov. Hidaka (M. TUSIMA, 1928); circ. Notoro-ko, prov. Abasiri (H. IWAMOTO, 1931).

Distr. The Kuriles, Kamtchatka and North America.

2) **Luzula** DE CANDOLLE in LAMARCK et DE CANDOLLE, Fl. Franc. I. (1805) p. 198. *-Juncus* LINNAEUS, Gen. pl. (1737) p. 104, pro pte. *-Juncodes* POST et O. KUNTZE, Lexic. gen. phanerog. (1904) p. 303.

Key to the Subgenera.

- 1 { Apex of leaf usually callose, rarely acute. Seed has a distinct caruncle..... 2
 { Apex of leaf usually acute or subulate. Seed has no distinct caruncle or has no caruncle at all (7) *Anthelaea* (p. 196)
- 2 { Caruncle present only at the chalazal end of the seed, and mostly as long as the seed..... (6) *Pterodes* (p. 193)
 { Caruncle present only at the micropylar end of the seed, and usually shorter than the seed (8) *Gymnodes* (p. 198)

(6) Subgen. *Pterodes* GRISEBACH, "Spicil. fl. bithyn. et rumel. (1845) p. 404."

Key to the Species.

- 1 { The undermost bract equal in length to the inflorescence. Cauline leaves longer and broader than radical leaves. Peduncles dichotomous *L. Jimboi* (p. 193)
- 1 { The undermost bract very much shorter than the inflorescence. Cauline leaves shorter and narrower than radical leaves. Peduncles not dichotomous 2
- 2 { Apical portion of tepals distinctly crenulate *L. japonica* (p. 193)
- 2 { Apical portion of tepals entire 3
- 3 { Anther shorter than filament. Capsule exceedingly rostrate *L. rostrata* (p. 195)
- 3 { Anther longer than filament. Capsule not so much rostrate, or often obtuse 4
- 4 { Capsule very much obtuse *L. formosana* (p. 193)
- 4 { Capsule not obtuse, but acute 5
- 5 { Flower mostly rufescent. Anther longer than filament. Capsule equal in length to the tepals or longer than the latter 6
- 5 { Flower not rufescent. Anther somewhat longer than filament. Capsule exceeds the tepals in length 7
- 6 { Plant 10-30 cm. high. Flower with a capsule 2.5 mm. long *L. rufescens* (p. 195)
- 6 { Plant 40 cm. high. Flower with a capsule 4 mm. long *L. rufescens* var. *macrocarpa* (p. 196)
- 7 { Capsule longer than the tepals 8
- 7 { Capsule very much shorter than the tepals *L. plumosa* var. *brachycarpa* (p. 194)
- 8 { Seed elliptically ovate with a long caruncle *L. plumosa* (p. 194)
- 8 { Seed sphaerical with a very small caruncle *L. plumosa* var. *sphaerosperma* (p. 195)

35. ***Luzula formosana*** OHWI in Act. Phytotax. Geobot. I. (1932) p. 79.

Nom. Jap. Sima-nukabosisô (OHWI).

Hab. Formosa: Mt. Arisan (U. FAURIE, no. 154, 1914,—type in Herb. Imp. Univ. Kyoto).

An endemic plant.

36. ***Luzula japonica*** BUCHENAU, Monogr. Juncac. (1890) p. 82 et Juncac. (1906) p. 46; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 186; HULTEN, Fl. Kamtchatka. I. (1927) p. 224; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1295 et ed. 2. (1931) p. 1528; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 291.

L. pilosa (non WILLD.) MIQUEL, Prol. Fl. Jap. (1866-67) p. 329; FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 96.

Juncodes japonicum O. KUNTZE, Rev. Gen. Pl. II. (1891) p. 724.

Nom. Jap. Miyama-kurobosisô (MATSUMURA), Miyama-nukabosisô (MIYABE).

Hab. Yezo: Hakodate, prov. Osima (K. TSUKAMOTO, no. 24).

Distr. Honsyu and Kamtchatka.

37. ***Luzula Jimboi*** MIYABE & KUDÔ in Trans. Nat. Hist. Soc. Sapporo, V. (1915) p. 37 et Fl. Hokkaido and Saghal. III. (1932) p. 290, Pl. V; MAKINO & NEMOTO, Fl. Jap.

(1925) p. 1295 et ed. 2. (1931) p. 1528; TATEWAKI, *Phytogeogr. Middle Kuril*. (1933) p. 263, 304.

Nom. Jap. Zinbô-sô (MIYABE & KUDÔ).

Hab. Kuriles: Sibetoro, Ins. Etorofu (K. JIMBO, 1891—type in Herb. Imp. Univ. Hokkaido).

An endemic plant.

38. ***Luzula plumosa*** E. MEYER (Fig. 5.-6, 7; Fig. 10.-3), *Luzul. Spec. in Linnæa*, XXII. (1849) p. 387; BUCHENAU, *Monogr. Juncac.* (1890) p. 85 et *Juncac.* (1906) p. 48; MATSUMURA, *Ind. Pl. Jap. II.* (1905) p. 187; KUDÔ, *Fl. Paramushir* (1922) p. 85; MAKINO & NEMOTO, *Fl. Jap.* (1925) p. 1295 et ed. 2. (1931) p. 1528; MIYABE & KUDÔ, *Fl. Hokkaido and Saghal. III.* (1932) p. 292; TATEWAKI, *Phytogeogr. Middle Kuril.* (1933) p. 242, 263, 274, 291.

L. pilosa (non WILLD.) MIYABE, *Fl. Kuril.* (1890) p. 267; TAKEDA, *Fl. Shikotan* (1914) p. 491.

L. pilosa var. *plumosa* FRANCHET, *Pl. Dabid. II.* (1888) p. 138; FORBES & HEMSLEY in *Journ. Linn. Soc. XXXVI.* (1903) p. 161.

L. japonica SAMUELSSON in HULTEN, *Fl. Kamtchatk. I.* (1927) p. 224, pro pte.

Juncus pilosa THUNBERG, *Fl. Jap.* (1784) p. 145.

Juncodes plumosum O. KUNTZE, *Rev. Gen. Pl. II.* (1891) p. 725.

Nom. Jap. Nukabosisô.

Hab. Honsyu: Mt. Nidosan, prov. Settu (J. MATSUMURA, 1879); Mt. Amagi, prov. Izu (eodem, 1883); Mt. Myôkô, prov. Etigo (S. MATSUDA, 1894); Mt. Makioyama, prov. Izumi (eodem, 1897); Yosino, prov. Yamato (eodem); Mt. Ôyama, prov. Sagami (J. MATSUMURA, 1900); Mt. Tukuba, prov. Hitati (eodem, 1903); Yunogô, prov. Mimasaka (G. KOIDZUMI, 1911); Kawaraziri, prov. Yamasiro (Takeuti, 1912); Mt. Tatuzumayama, prov. Suruga (J. SUGIMOTO, 1920); Sukagawa, prov. Iwasiro (S. HATTORI, 1922); Mt. Daisen, prov. HOKI (M. FURUMI, 1924); Naigû-sineki, prov. Ise (M. HONDA, 1927); Hakone, prov. Sagami (Y. MOMIYAMA, 1929, 1930); Mt. Amagi, prov. Izu (T. NAKAI, 1931); Mt. Kiyosumi, prov. Awa (eodem, 1932). Sikoku: Mt. Turugisan, prov. Awa (J. NIKAI, 1904); Ko-mura, prov. Awa (eodem, 1905). Kyusyu: Mt. Hikosan, prov. Buzen (S. HAMADA, 1904 et 1906); Nisize, prov. Higo (K. MAYEBARA, 1923); Mt. Aso, prov. Higo (T. NAKAI, 1926).

Distr. The Kuriles, Yezo, China, Kamtchatka and Himalaya.

var. ***brachycarpa*** SATAKE, var. nov. (Fig. 22.-4, 5).

Tepala interna lanceolato-oblonga obtusa mucronata conspicue longiora, tepalis externis acutis. Fructus tepalis externis brevior. Semina ovata ca. 1 mm. longa, carunculis majoribus.

Nom. Jap. Inaba-nukabosisô (nov.).

Hab. Honsyu: Yasiro-mura, prov. Inaba (Y. IKOMA, 1915—type in Herb. Imp. Univ. Tokyo).

An endemic plant.

This new variety is easily distinguishable from the type in having the inner tepals longer than the outer ones and in having the capsules very much shorter than the outer tepals.

var. **sphaerosperma** SATAKE, var. nov. (Fig. 22.-1, 2, 3).

Tepala aequilonga, externa acuta, interna obtusa vel acutiuscula. Fructus tepala aequans vel paulo superans, apice mucronatus. Semina globularia, ca. 1.3 mm. longa et lata, carunculis minoribus.

Nom. Jap. Saikoku-nukabosisô (nov.).

Hab. Honsyu: Mt. Higasihôben-zan, prov. Nagato (T. GOYA, no. 33, 1904—type in Herb. Imp. Univ. Tokyo).

An endemic plant.

The present new variety is clearly distinguished from the type in having the obtuse inner tepals and spherical seeds with a small caruncle.

39. **Luzula rostrata** BUCHENAU (Fig. 10.-5; Fig. 16.-3, 4), Juncac. (1906) p. 47; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 187; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1296 et ed. 2. (1931) p. 1528; NAKAI, Rep. Veg. Daisetuzan (1930) p. 60; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 292.

Nom. Jap. Miyama-nukabosisô, Miyama-suzumenohie (MIYABE & KUDÔ).

Hab. Yezo: Mt. Daisetuzan, prov. Isikari (T. NAKAI, 1928); ibidem (Y. SATAKE, 1931). Honsyu: Nikko, prov. Simotuke (J. MATSUMURA, 1878); Aizu, prov. Iwasiro (eodem, 1879); Mt. Haku-san, prov. Kaga (eodem, 1881); ibidem (J. NIKAI, 1909); Mt. Yudonosan, prov. Uzen (J. MATSUMURA, 1887); ibidem (ÔKUBO, 1887); Sibata, prov. Etigo

(YAMAMOTO, 1908); Nikko, prov. Simotuke (G. KOIDZUMI, 1913); ibidem (T. NAKAI, 1919); ibidem (Y. YAMAMOTO, 1923); ibidem (F. MAEKAWA, 1931); ibidem (Y. MOMIYAMA, 1931); Mt. Hakkôda, prov. Mutu (S. HATTORI, 1926); Kamikôti, prov. Sinano (T. NAKAI, 1927); Mt. Komagadake, prov. Kai (Y. SATAKE, 1932).

An endemic plant.

40. **Luzula rufescens** FISCHER in Linnaea, XXII. (1849) p. 385; FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 96; BUCHENAU, Monogr. Juncac. (1890) p. 81 et Juncac. (1906) p. 46; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 187; KOMAROV, Fl. Manschur.



Fig. 22. 1-3. *Luzula plumosa* var. *sphaerosperma* SATAKE. 4-5. *L. plumosa* var. *brachycarpa* SATAKE. 1, 5. flowers with mature capsules; 2. tepals with 3 stamens; 3, 4. seeds with chalazal caruncles. \times ca. 8.

I. (1901) p. 429; NAKAI, Fl. Koreana, II. (1911) p. 269; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1296 et ed. 2. (1931) p. 1529; HULTEN, Fl. Kamtschatk. IV. (1930) p. 245; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 283; YAMAZUTA, List of Manchur. Pl. (1930) p. 56; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 291.

L. rufescens var. *brevipes* FRANCHET & SAVATIER, l. c.

Juncodes rufescens O. KUNTZE, Rev. Gen. Pl. II. (1891) p. 725.

Nom. Jap. Kurobosisô.

Hab. Korea: Mt. Chiisan (T. NAKAI, 1913); Zyosuisai (M. FURUMI, 1917); Ins. Quelpaert (T. TAQUET, 1911).

Distr. Saghalien, Yezo, Manchuria, Amur, Siberia, Kamtschatka and North America.

var. **macrocarpa** BUCHENAU (Fig. 10.-4), l. c. (1906) p. 47; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 493; MORI, Enum. Pl. Corea (1922) p. 83; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 292.

L. macrocarpa NAKAI, Rep. Veg. Quelpaert (1914) p. 30.

L. macrocarpa var. *laxa* NAKAI, l. c.

Nom. Jap. Kôrai-nukabosisô (NAKAI), Saisyu-nukabosisô (NAKAI), Ô-nukabosisô (MIYABE & KUDÔ).

Hab. Korea: Mt. Hallaisan Ins. Quelpaert (T. NAKAI, 1913); Kaugkai (R. G. MILLS, no. 533 et 535, 1911); northern Korea (KOMAROV, 1897).

Distr. Saghalien and Amur.

(7) Subgen. *Anthelaea* GRISEBACH, "Specil. fl. bithyn. et rumel. (1845) p. 404."

Key to the Species.

- | | | | |
|---|---|---|---|
| 1 | { | Cauline leaves plane, about 10-15 cm. long, 5-10 mm. broad, usually longer and broader than the radical leaves. Inflorescence decomposed. Tepals and bracts of a flower distinctly crenulate | <i>L. parviflora</i> var. <i>melanocarpa</i> (p. 197) |
| | | Cauline leaves 3-10 cm. long, 1-3 (rarely 5) mm. broad, usually shorter and narrower than the radical leaves, canaliculate towards the apex. Inflorescence compound. Tepals entire, and bracts of a flower mostly ciliate | 2 |
| 2 | { | Radical leaves narrow, about 2-4 (rarely 5) mm. broad. Tepals ovate, membranaceous and equal in length. Seed provided with slender fibres at the micropylar end | <i>L. Wahlenbergii</i> (p. 197) |
| | | Radical leaves about 6-10 mm. often 18 mm. broad. Tepals ovato-lanceolate and somewhat coriaceous at the dorsal part; the inner ones longer than the outer ones. Seed provided with no slender fibre at the micropylar end..... | 3 |
| 3 | { | Leaves very much broad, usually 8-10 mm. broad, more or less shining..... | <i>L. chinensis</i> (p. 196) |
| | | Leaves under 6 mm. broad, not shining..... | <i>L. effusa</i> (p. 197) |

41. **Luzula chinensis** N. E. BROWN in Journ. Linn. Soc. Bot. XXXVI. (1903) p. 161; BUCHENAU, Juncac. (1906) p. 61.

Nom. Jap. Hiroha-no-niitakanukabosi (nov.).

Hab. Formosa: Mt. Gôkanzan (B. HAYATA, 1916).

Distr. China.

New to the flora of Formosa.

42. **Luzula effusa** BUCHENAU (Fig. 16.-1, 2), Krit. Verz. aller Juncac. (1880) p. 53, 88, Monogr. Juncac. (1890) p. 106 et Juncac. (1906) p. 61; HAYATA, Fl. Mont. Formos. (1908) p. 228; SASAKI, List of Pl. Formos. (1928) p. 102 et Catal. Govern. Herb. (1930) p. 122; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1295 et ed. 2. (1931) p. 1528.

Juncodes spadiceum var. *effusum* O. KUNTZE, Rev. Gen. Pl. II. (1891) p. 724.

Nom. Jap. Niitaka-nukabosi (HAYATA).

Hab. Formosa: Mt. Morrison (T. KAWAKAMI et U. MORI, 1906); ibidem (G. NAKAHARA, 1905).

Distr. China and Himalaya.

43. **Luzula parviflora** DESVAUX in Journ. de Bot. I. (1808) p. 144.

var. **melanocarpa** BUCHENAU, Krit. Verz. aller Juncac. (1880) p. 83, Monogr. Juncac. (1890) p. 83 et Juncac. (1906) p. 62; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 293.

L. spadicea var. *melanocarpa* MEYER in Linnaea, XXII. (1849) p. 403.

Juncus melanocarpus MICHX. Fl. bor.-Amer. I. (1803) p. 190.

Nom. Jap. Kogome-nukabosi (MIYABE & KUDÔ).

Distr. Kuriles, Kamtchatka, Siberia, Europe and North America.

44. **Luzula Wahlenbergii** RUPRECHT (Fig. 5.-4, 5), Beitr. Pflanzenk. Russ. II. (1845) p. 58; KURTZ in ENGLER, Bot. Jahrb. XIX. (1895) p. 476; HULTEN, Fl. Kamtschat. I. (1927) p. 230; KOMAROV, Fl. Pen. Kamtschat. I. (1927) p. 285; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1296 et ed. 2. (1931) p. 1529; NAKAI, Rep. Veg. Daisetzuan (1930) p. 60; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 293; SATAKE in Bot. Mag. Tokyo, XLVI. (1932) p. 187; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 243, 263, 274, 292 et 304.

L. spadicea var. *Wahlenbergii* BUCHENAU in ENGLER, Bot. Jahrb. VII. (1885) p. 171, Monogr. Juncac. (1890) p. 112 et Juncac. (1906) p. 63; KUDÔ, Fl. Paramushir (1922) p. 65.

L. spadicea var. *Kunthii* MEYER in Linnaea, XXII. (1849) p. 403.

Nom. Jap. Kumoma-suzumenohie.

Hab. Kuriles: Ins. Urup (M. TATEWAKI, 1927). Yezo: Mt. Daisetzuan, prov. Ishikari (G. KOIDZUMI, 1916); ibidem (T. NAKAI, 1928); ibidem (Y. SATAKE, 1931). Honsyu: Mt. Tateyama, prov. Ettyû (J. MATSUMURA, 1884); ibidem (K. KIMURA, 1928); Mt. Komagadake, prov. Kai (K. WATANABE, 1895); ibidem (Y. SATAKE, 1932); Mt. Ontake, prov. Sinano (G. KOIDZUMI, 1910); Mt. Komagadake, prov. Sinano (G. KOIDZUMI, 1917); Mt. Sirouma, prov. Sinano (M. HONDA, 1928). Corea: Mt. Hakutôzan (T. NAKAI, 1914).

Distr. Kamtchatka, Siberia, North America and Europe.

(8) Subgen. *Gymnodes* GRISEBACH, "Specil. fl. bithyn. et rumel. (1845) p. 405."

Key to the Species.

- 1 { Inflorescence compactly coarctate 2
- 1 { Inflorescence not coarctate, but divided into several or many small heads..... 4
- 2 { Inflorescence forms an elongated elliptical or oblong spike *L. taiwaniana* (p. 202)
- 2 { Inflorescence forms a shortly ovate or rounded spike (rarely divided into 2-3 heads)... 3
- 3 { Tepals crenulately denticulate towards the apex. Anther nearly as long as the filament.
- 3 { Caruncle very small *L. Kjellmanniana* (p. 199)
- 3 { Tepals entire. Anther twice as long as the filament. Caruncle one half as long as the seed *L. capitata* (p. 198)
- 4 { Caruncle nearly absent. Capsule shorter than the tepals. Floral bracts and prophylls lacerately ciliate. Anther as long as the filament.....
- 4 { *L. arcuata* var. *unalaschkensis* (p. 198)
- 4 { Caruncle small or large. Capsule as long as or longer than the tepals, rarely shorter. Floral bracts and prophylls not so much ciliate as the above species. Anther twice as long as or equal to or shorter than the filament..... 5
- 5 { Capsule 2.5-3 mm. long. Caruncle one half as long as the seed 6
- 5 { Capsule 2-2.5 mm. long. Caruncle very short 7
- 6 { Inflorescence consists of many small heads. Capsule brown or chestnut-coloured.....
- 6 { *L. multiflora* (p. 199)
- 6 { Inflorescence consists of 2-3 heads. Capsule very yellowish *L. multiflora* var. *lutescens* (p. 200)
- 7 { Inflorescence consists of many small heads. Flower pallescent. Capsule as long as the tepals. Anther equal in length to the filament or longer than the latter.....
- 7 { *L. pallescens* (p. 201)
- 7 { Inflorescence consists of few heads. Flower chestnut-coloured or blackish chestnut-coloured. Anther one half as long as the filament. Capsule longer than the tepals *L. oligantha* (p. 201)

45. ***Luzula arcuata*** WAHLENBERG, Fl. suecica. I. (1824) p. 218.

var. ***unalaschkensis*** BUCHENAU, Monogr. Juncac. (1890) p. 124 et Juncac. (1906) p. 70; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 293; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 292.

L. arcuata var. *kamtschadalorum* SAMUELSSON in HULTEN, Fl. Kamtchatk. I. (1927) p. 223.

Nom. Jap. Tisima-nukabosi (MIYAKE & KUDÔ).

Distr. The Kuriles, Kamtchatka, the Aleutian Islands, Unalaska and the Bering-Sea Regions.

46. ***Luzula capitata*** NAKAI (Fig. 5.-1, 2, 3; Fig. 10.-2), Rep. Veg. Apoi (1930) p. 76; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 295; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 219, 243.

L. campestris var. *capitata* MIQUEL, Prol. Fl. Jap. (1866-67) p. 329; FRANCHET & SAVATIER, Enum. Pl. Jap. II. (1879) p. 97; BUCHENAU, Monogr. Juncac. (1890) p. 160 et

Juncac. (1906) p. 92; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 186; KOIDZUMI, Pl. Sachal. Nakahara. (1910) p. 31; NAKAI, Fl. Koreana, II. (1911) p. 268; TAKEDA, Fl. Shikotan (1914) p. 490; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 494; KUDÔ, Fl. Paramushir (1922) p. 87; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1294 et ed. 2. (1931) p. 1527; YAMAZUTA, List of Manchur. Pl. (1930) p. 56.

L. campestris var. *congesta* MIYABE, Fl. Kuril. (1890) p. 267.

L. capitata (non MIQUEL) KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 288.

Nom. Jap. Suzumeno-hie, Suzumeno-yari, Sibaimo.

Hab. Saghalien: Trechapachs (G. NAKAHARA, 1916); Sakaihamma (T. SAWADA, 1923); Ôdomari (eodem). Yezo: Titose, prov. Iburi (K. MIYABE, 1884); Kamuikotan, prov. Isikari (H. KOIDZUMI, 1912); Hakodate, prov. Osima (K. TSUKAMOTO, 1926); Mt. Apoi, prov. Hidaka (T. NAKAI, 1928). Honsyu: Nagakubo, prov. Musasi (J. MATSUMURA, 1877); Tokyo, prov. Musasi (leg. ? 1879); Yugasima, prov. Izu (J. MATSUMURA, 1883); Ins. Ôsima, prov. Izu (eodem, 1887); Ôuti-mura, prov. Suô (J. NIKAI, 1892); Yunogô, prov. Mimasaka (G. KOIDZUMI, 1911); Prov. Inaba (Y. IKOMA, 1915); Tokyo, prov. Musasi (S. HATTORI, 1921). Sikoku: Kamomyo-mura, prov. Awa (J. NIKAI, 1913). Kyusyu: Nagasaki, prov. Hizen (J. MATSUMURA, 1879); Hukuoka, prov. Tikuzen (N. OKADA, 1900); Izuhara, prov. Tusima (K. HIRATA, 1902); Asibe, prov. Iki (K. OHKI, 1925). Corea: Keizyô (N. OKADA, 1909); Genzan (T. NAKAI, 1909); Mt. Hokkanzan (T. MORI, 1912); Suigen (S. UEKI, 1912); Mt. Hallaisan, Ins. Quelpaert (T. NAKAI, 1913); Andong (R. K. SMITH, 1915); Ins. Kyomon (T. NAKAI, 1928); Ins. Quelpaert (T. TAQUET, 1911); ibidem (T. NAKAI, 1913).

Distr. The Kuriles, Manchuria and Kamtschatka.

47. ***Luzula Kjellmanniana*** MIYABE & KUDÔ in Trans. Nat. Hist. Soc. Sapporo, V. (1913) p. 38; KUDÔ, Fl. Paramushir (1922) p. 86, excl. syn.; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1295 et ed. 2. (1931) p. 1528; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 294; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 219, 243, 263, 274, 292, 304.

L. japonica (non BUCHEN.) YABE & YENDÔ in Bot. Mag. Tokyo, XVIII. (1904) p. 174.

L. campestris var. *multiflora* (non CELAKOV.) YABE & YENDÔ, l. c.

L. campestris var. *sudetica* (non CELAKOV.) KUDÔ, l. c.

L. sudetica (non DC) KOMAROV, Fl. Pen. Kamtschat. I. (1927) p. 287.

L. multiflora var. *Kjellmanniana* SAMUELSSON in HULTEN, Fl. Kamtschatk. I. (1927) p. 227; SATAKE in Bot. Mag. Tokyo, XLVI. (1932) p. 187.

Nom. Jap. Tisima-suzumenohie (MIYABE & KUDÔ).

Distr. The Kuriles, Saghalien, Yezo, Kamtschatka and Bering Sea Regions.

48. ***Luzula multiflora*** (Fig. 16.-5, 6) LEJEUNE, Fl. Envir. Spa. I. (1811) p. 169; HULTEN, Fl. Kamtschatk. I. (1927) p. 226; KOMAROV, Fl. Pen. Kamtschat. I. (1927) p. 287; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 295; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 219 et 243.

L. campestris var. *multiflora* CELAKOVSKY, Prod. Fl. Bohmen (1869) p. 85; BUCHENAU, Monogr. Juncac. (1890) p. 161 et Juncac. (1906) p. 94; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 186; MIYABE & MIYAKE, Fl. Saghal. (1915) p. 493; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1294 et ed. 2. (1931) p. 1527.

L. campestris (non DC) MIYABE, Fl. Kuril. (1890) p. 267.

L. campestris var. *intermedia* KOIDZUMI, Pl. Sachal. Nakahara. (1910) p. 32; MAKINO & NEMOTO, l. c. (1925) p. 1294 et (1931) p. 1527.

L. multiflora var. *intermedia* NAKAI, Rep. Veg. Daisetuzan (1930) p. 60.

Nom. Jap. Yama-suzumenohie.

Hab. Saghalien: Dobuki (G. NAKAHARA, 1906); Tretiya-padj (eodem). Yezo: Mt. Daisetuzan, prov. Isikari (T. NAKAI, 1928). Honsyu: Nikko, prov. Simotuke (J. MATSUMURA, 1878); Nakano, prov. Musasi (T. MAKINO, 1894); Ôme, prov. Musasi (J. MATSUMURA, 1900); Mt. Ôyama, prov. Sagami (eodem); Yunogô, prov. Mimasaka (G. KOIDZUMI, 1911); Honga, prov. Inaba (Y. IKOMA, 1914); Koti, prov. Nagato (J. NIKAI, 1917); Tikanori, prov. Bittyû (Z. TASIRO, no. 501-503, 1916); Matuyama, prov. Bittyû (eodem); Nikko, prov. Simotuke (M. HONDA, 1924); ibidem (Y. MOMIYAMA, 1931); Yosida, prov. Kai (Y. MOMIYAMA, 1930); Hakone, prov. Sagami (eodem). Sikoku: Ikeda, prov. Sanuki (R. HIRAMA, 1910). Corea: Tokugen, Kankyô-nandô (T. NAKAI, 1909); Ins. Kyosai (eodem, 1928). Formosa: Mt. Sitiseizan (T. KAWAKAMI et S. SASAKI, 1911).

Distr. The Kuriles, Manchuria, Amur, China, Kamtchatka, North America, Europe and Australia.

var. *lutescens* (KOIDZUMI) comb. nov. (Fig. 23).

L. campestris var. *lutescens* KOIDZUMI in MATSUMURA, Icon. Pl. Koisikav. I. (1912) p. 105, Pl. LIII;

MAKINO & NEMOTO, l. c. (1925) p. 1294 et (1931) p. 1527.

Nom. Jap. Asagi-suzumenohie (KOIDZUMI).

Hab. Honsyu: Mt. Togakusi, prov. Sinano (J. MATSUMURA, 1884); Ôuti-mura, prov. Suô (J. NIKAI, 1892); ibidem (S. MATSUDA, 1893); Mt. Huzi, prov. Suruga (S. MATSUDA, 1906); Kameyama, prov. Suô (T. GOYA, 1904); Yamato, prov. Bittyû (Z. YOSHINO, no. 504, 1916); Tikamori, prov. Bittyû (eodem, no. 505, 1916). Sikoku: Nanokawa, prov. Tosa (K. WATANABE, 1896).

An endemic plant.

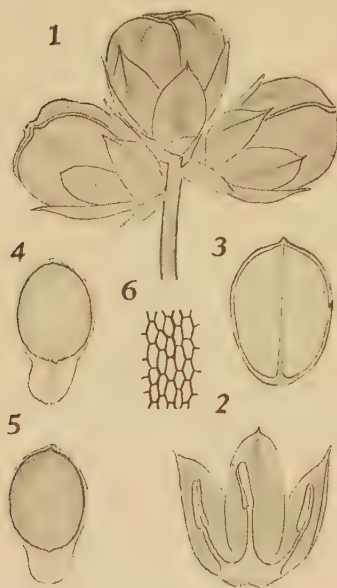


Fig. 23. *Luzula multiflora* var. *lutescens* SATAKE. 1. a head with 3 flowers with mature capsules; 2. tepals with 3 stamens; 3. a carpel; 4-5 seeds with micropylar caruncles; 6. tegmen. 1, 3 = \times ca. 8; 2, 4, 5 = \times ca. 11; 6 = \times ca. 37.

49. **Luzula oligantha** SAMUELSSON in HULTEN, Fl. Kamtchatk. I. (1927) p. 227 et IV. (1930) p. 245; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 294; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 243, 263, 292.

L. campestris var. *pauciflora* BUCHENAU, Juncac. (1906) p. 88; MATSUMURA, Ind. Pl. Jap. II. (1905) p. 186; NAKAI, Fl. Koreana, II. (1911) p. 269; MORI, Enum. Pl. Corea (1922) p. 83; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1294 et ed. 2. (1931) p. 1527.

L. campestris var. *sudetica* (non CELAKOV.) MATSUMURA, l. c.

L. sudetica var. *pauciflora* NAKAI, Reg. Veg. Daisetuzan (1930) p. 60.

Nom. Jap. Takane-suzumenohie, Kuro-takane-suzumenohie.

Hab. Yezo: Mt. Daisetuzan, prov. Isikari (K. TSUKAMOTO, 1926); ibidem (T. NAKAI, 1928); ibidem (Y. SATAKE, 1931); Ins. Riziri, prov. Kitami (S. AKIYAMA, 1928). Honsyu: Mt. Tyôkaizan, prov. Ugo (S. ISIZAKA, 1884); Mt. Komagadake, prov. Sinano (J. MATSUMURA, 1880); Mt. Ontake, prov. Sinano (R. YATABE, 1880); ibidem (G. KOIDZUMI, 1910); ibidem (J. NIKAI, 1911); Mt. Huzi, prov. Suruga (J. MATSUMURA, 1881); Roku-zyurigoe, prov. Uzen (eodem, 1887); Mt. Sirouma, prov. Sinano (Y. YABE, 1902); Mt. Sirane, prov. Simotuke (T. NAKAI, 1919); ibidem (S. HATTORI, 1922); Mt. Hakkôda, prov. Mutu (G. KOIDZUMI, 1914); Mt. Hiziridake, prov. Sinano (T. SAWADA, 1921); Nikko, prov. Simotuke (Y. YAMAMOTO, 1923); Kamikôti, prov. Sinano (T. NAKAI, 1927); Mt. Yatugadake, prov. Sinano (W. SATO, no. 1, 5 et 19); Mt. Nantai, prov. Simotuke (Y. MOMIYAMA, 1931). Sikoku: Mt. Turugisan, prov. Awa (J. NIKAI, 1909). Corea: Mt. Hakutôzan (K. HIRAI, 1913); ibidem (T. NAKAI, 1914); Mt. Tyôhakusan (T. MORI, 1913); Seturei, Kankyô-nandô (T. NAKAI, 1918).

Distr. The Kuriles, Kamtchatka and China.

50. **Luzula pallescens** BESSER, Enum. Pl. Volh. Pod. (1822) p. 15; HULTEN, Fl. Kamtchatk. I. (1927) p. 228; KOMAROV, Fl. Pen. Kamtschatk. I. (1927) p. 286; MIYABE & KUDÔ, Fl. Hokkaido and Saghal. III. (1932) p. 294; TATEWAKI, Phytogeogr. Middle Kuril. (1933) p. 219.

L. campestris var. *pallescens* WAHLENBERG, Fl. suec. I. (1824) p. 218; BUCHENAU, Monogr. Juncac. (1890) p. 163 et Juncac. (1906) p. 88; MORI, Enum. Pl. Corea (1922) p. 83.

Nom. Jap. Oka-suzumenohie.

Hab. Honsyu: Mt. Togakusi, prov. Sinano (S. MATSUDA, 1893); Toda, prov. Suô (leg.? 1906); Prov. Inaba (Y. IKOMA, 1915); Tubakigô-higashibun-mura, prov. Nagato (J. NIKAI, no. 2693 et 2694, 1917); Nikko, prov. Simotuke (T. NAKAI, 1919); ibidem (Y. MOMIYAMA, 1931); Mt. Sirane, prov. Simotuke (S. HATTORI, 1922); Mt. Ômine, prov. Kii (S. SAKAGUCHI, 1930). Kyusyu: Ithusa, prov. Higo (K. MAYEBARA, 1928). Corea: Cham-gion (KOMAROV, no. 356, 1897); Zyôsin, Kankyô-hokudô (T. NAKAI, 1909); Genzan, Kankyô-nandô (eodem); Mt. Hotaizan (M. FURUMI, 1917); Ins. Quelpaert (T. TAQEUT, 1912).

Distr. The Kuriles, Saghalien, Yezo, Kamtchatka, Amur, Manchuria and Europe.

51. *Luzula taiwaniana* SATAKE, sp. nov. (Fig. 24 et Pl. IV.)

L. spicata (non DC) HAYATA, Fl. Mont. Formos. (1908) p. 229; MAKINO & NEMOTO, Fl. Jap. (1925) p. 1296 et ed. 2. (1931) p. 1529; SASAKI, List of Pl. Formos. (1928) p. 103.

Caules erecti 13–23 cm. alti caespitosi. Folia caulina 1–2, 4–6 cm. longa, 1–2 mm. lata, canaliculata, apice callosa; folia basilaria numerosa, 4–10 cm. longa et 2–4 mm. lata, valde canaliculata, reflexa. Inflorescentia spicata conglobata, elliptico-oblonga, erecta, 1–2.5 cm.

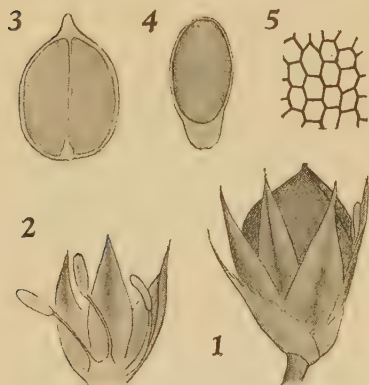


Fig 24. *Luzula taiwaniana* SATAKE.
1. a flower with a mature capsule; 2. tepals with 3 stamens; 3. a carpel; 4. a seed with a micropylar caruncle; 5. tegmen. 1, 2, 3 = \times ca. 8; 4 = \times ca. 11; 5 = \times 75.

longa et 5–10 mm. lata, simplex vel rarius lobata; spiculae breves densae, 5–8 flores; bractea infima frondosa, inflorescentia longior; bracteae florum floribus conspicue breviores, longe ciliatae. Tepala aequilonga lanceolata acutissima, medio castanea, apice albo-membranacea. Stamina 6, tepalis paulo breviora; antherae oblongae filamentis conspicue breviores. Fructus perigonium aequans vel paulo brevior, trigono-sphaericus, breve mucronatus, castaneus vel ferrugineus. Semina elliptico-obovata, ca. 1.3 mm. longa, carunculis brevissimis, hexagonaliter reticulata.

Nom. Jap. Taiwan-suzumenohie (HAYATA).

Hab. Formosa: Mt. Nôkôzan (E. MATUDA, 1919—type in Herb. Imp. Univ. Tokyo); Mt. Morri-son (T. KAWAKAMI et U. MORI, 1906); Mt. Gôkan-zan (B. HAYATA, 1916).

An endemic plant.

This new species which was first identified with *Luzula spicata* DC. by Professor B. HAYATA is distinctly separable from the latter as follows: In *L. spicata* DC. the inflorescence is flexible and reflexed sideways or downwards, and the floral bracts are as long as the flowers and are very much ciliate, while in the present new species the inflorescence is rigid and erect, but not reflexed at all, and the floral bracts are about one half as long as the flowers and are not so ciliate as in *L. spicata* DC.

V. Distribution of the Japanese Juncaceae in Japan and in the Neighbouring Regions.

As we see in the foregoing pages, there are in Japan in all 45 species and 19 varieties. Now we shall first consider the distribution of each species in Japan which is phytogeographically divided into 10 districts—the Kuriles, Saghalien, Yezo, Honsyu, Corea, Sikoku, Kyusyu, the Ryukyus, Formosa and the Bonins, and then that in the neighbouring regions. For convenience sake,

let us suppose that each of the species as well as of the varieties here represents an element, and 45 species and 19 varieties as representing altogether 64 elements.

As we shall see in the following table, Honsyu containing 39 elements (26 species and 13 varieties) stands at the head of the 10 districts; then comes Yezo with 34 elements (28 species and 6 varieties), the Kuriles 27 elements (23 species and 4 varieties), Corea 26 elements (17 species and 9 varieties), Saghalien 17 elements (12 species and 5 varieties), Kyusyu 16 elements (11 species and 5 varieties), Sikoku 13 elements (9 species and 4 varieties), Formosa with 12 elements (9 species and 3 varieties), and finally the Ryukyus with 4 elements (1 species and 3 varieties). It should be noticed that the Bonins have no elements.

Table I. showing the numbers of elements possessed by the different districts and their ratios to the total number of elements in Japan, shown in percentage.

Districts	Numbers of species	Numbers of varieties	Numbers of elements	Their ratios to the total number of elements
Honsyu	26	13	39	ca. 60%
Yezo	28	6	34	ca. 53%
Kuriles	23	4	27	ca. 41%
Corea	17	9	26	ca. 40%
Saghalien	12	5	17	ca. 26%
Kyusyu	11	5	16	25%
Sikoku	9	4	13	ca. 20%
Formosa	9	3	12	ca. 18%
Ryukyus	1	3	4	ca. 6%
Bonins	0	0	0	0

As is shown in the above table, we understand that larger number of the *Juncaceae* grow in the north-eastern parts in Japan, but smaller number in the south-western parts. The cause of this dissimilar distribution is probably explainable by the assumption that the north-eastern districts presumably connected in some geological ages with the continents of Asia and North America, and consequently the plants of the latter continents might have migrated to Japan, while the south-western districts beared not so much relation as the north-eastern districts to the continent of Asia, to be given any plant to the elements of their own. Thus stating, it will be all the more interesting to see that there is no element whatever in the Bonin Islands.

It is generally considered that the flora of East Asia has little relation to those of the other continents. This is also the case with the *Juncaceae*. Some of the Japanese rushes are endemic, but some are found in other parts of East Asia. Now let us assume five kinds of elements for the consideration of distribution of species in Japan and neighbouring regions.

1. Common elements.
2. Endemic elements.
3. North-eastern elements.
4. Northern and north-western elements.
5. South-western elements.

1. By the common elements are meant those distributed in the continents of Europe, North America and Asia. As these are counted the following 11 elements (10 species and 1 variety): *Juncus bufonius*, *J. tenuis*, *J. filiformis*, *J. lampocarpus*, *J. castaneus*, *J. stygius*, *J. triglumis*, *Luzula Wahlenbergii*, *L. multiflora*, *L. pallescens* and *L. parviflora* var. *melanocarpa*. The common elements amounts to about 17% of the total sum of the elements.

2. By the endemic elements are meant those growing exclusively in the Japanese Empire including Formosa in the south, Sagalien and the Kuriles in the north and Corea in the west-north. As these are counted the following 25 elements (14 species and 11 varieties): *Juncus leptocladus* (Formosa), *J. curvatus* (the Kuriles, Saghalien, Yezo and Honsyu), *J. Fauriei* (the Kuriles, Yezo, Saghalien, Honsyu and Kyusyu), *J. bombonzanensis* (Formosa), *J. nikkoensis* (Honsyu) and var. *minor* (Honsyu), *J. togakusiensis* (Honsyu), *J. Tokubuchii* (Yezo), *J. yakeisidakensis* (Honsyu), *J. Maximowiczii* (Honsyu and Corea), *J. oligocephalus* (Honsyu, Yezo and the Kuriles), *J. tenuis* var. *Nakaii* (Honsyu), *J. decipiens* var. *gracilis* (the Kuriles, Saghalien, Yezo, Honsyu and Sikoku), var. *glomeratus* (the Kuriles, Saghalien, Yezo, Honsyu and Corea), *J. setchuensis*

var. *compactus* (Corea), *J. Fauriensis* var. *iwatensis* (Honsyu), *J. castaneus* var. *koreanus* (Corea), *J. prismatocarpus* var. *Leschenaultii* subvar. *viviparus* (Honsyu, Kyusyu and the Ryukyus), *Luzula formosana* (Formosa), *L. taiwaniana* (Formosa), *L. rostrata* (Yezo and Honsyu), *L. Jimboi* (the Kuriles), *L. plumosa* var. *brachycarpa* (Honsyu), var. *sphaerosperma* (Honsyu) and *L. multiflora* var. *lutescens* (Honsyu and Sikoku).

The endemic elements amount to 39% of the total elements. The following table shows the different numbers of the elements endemic to the Japanese Empire in different districts and their ratios to the total number of the same endemic elements.

Table II. showing the distribution of elements endemic to the Japanese Empire in different districts and their ratios to the total number of the same endemic elements.

Districts	Endemic species	Endemic varieties	Endemic elements	Their ratios to total endemic elements (25)
Honsyu	8	9	17	68%
Yezo	5	2	7	28%
Kuriles	4	2	6	24%
Saghalien	2	2	4	16%
Formosa	4	0	4	16%
Corea	1	3	4	16%
Sikoku	0	2	2	8%
Kyusyu	1	1	2	8%
Ryukyus	0	0	0	0
Bonins	0	0	0	0

As is shown in the above table, Honsyu is the richest in endemic elements possessing 68%, next is Yezo possessing 28%, and then comes the Kuriles possessing 24%. It seems at a glance that the endemic plants grow mostly in the north-eastern districts, but becomes fewer in the south-western, but in a closer examination this is not strictly so. If we compare the elements endemic to the Japanese Empire contained in each of the different districts with all the elements in the same district, we shall find that Formosa comes next to Honsyu, in stead of next to Saghalien as is shown in the foregoing table. The following table shows the numbers of the elements endemic to the Japanese Empire in each of the different districts, those of all elements in the same district and their ratios in percentage.

Table III.

Districts	Numbers of endemic elements	Numbers of all the elements	Ratios of the two numbers shown in percentage
Honsyu	17	39	ca. 43%
Formosa	4	12	ca. 33%
Saghalien	4	17	ca. 23%
Kuriles	6	27	ca. 22%
Yezo	7	34	ca. 20%
Sikoku	2	13	ca. 15%
Corea	4	26	ca. 15%
Kyusyu	2	16	ca. 13%
Ryukyus	0	4	0
Bonins	0	0	0

Now, turning our attention to another side of the view, we shall compare the elements peculiar to each of the different districts with all the elements in the same district under consideration. Then the most interesting fact will be found that Formosa which comes in the fifth in the table II and in the second in the table III, possessing 33% of the peculiar elements, stands in the head of the order, while Honsyu which comes in the first in the table II and III stands next to Formosa, as is shown in the following table.

Table IV.

Districts	Numbers of elements peculiar to the district	Numbers of all the elements in the district	Ratios of the two numbers shown in percentage
Formosa	4	12	ca. 33%
Honsyu	8	39	ca. 20%
Corea	2	26	ca. 8%
Kuriles	1	27	ca. 4%
Yezo	1	34	ca. 3%
Saghalien	0	17	0
Kyusyu	0	16	0
Sikoku	0	13	0
Ryukyus	0	4	0
Bonins	0	0	0

This fact shows that the flora of Formosa is very peculiar and must have been developed nearly independently from the floras of the other districts.

This peculiarity of the flora of the island is probably caused by the possible existence of a land mass connecting Formosa and the continent of Asia in some geological times.

3. By the north-eastern elements are meant those distributed from Yezo, southern Saghalien and the Kuriles to Kamtchatka, the Aleutian Islands, the Bering Sea Regions, Alaska and the north-western regions of North America. They are in all 10 in number (9 species and 1 variety): namely, *Juncus beringensis*, *J. Haenkei*, *J. Fauriensis*, *J. kamschatcensis*, *J. prominens*, *J. Mertensianus*, *Luzula japonica*, *L. rufescens*, *L. Kjellmanniana*, *L. arcuata* var. *unalaschkensis*. They amount to 18% of all the elements 64 (*J. Haenkei* and *L. rufescens* are also found among the next elements).

4. By the northern and north-western elements are meant those distributed on the one hand from Corea to Manchuria, northern China, Ussuri, Amur and Siberia, and on the other hand from southern Saghalien to northern Saghalien and East Siberia. They are represented by most common species in Japan and amount to 13 (8 species and 5 varieties): namely, *Juncus decipiens*, *J. papillosus*, *J. Krameri*, *J. Haenkei*, *J. prismatocarpus* var. *Leschenaultii* subvar. *pluritubulosus* and subvar. *unitubulosus*, *J. compressus* var. *gracillimus*, *J. brachyspathus*, *J. luzuliformis* var. *Potaninii*, *Luzula capitata*, *L. oligantha*, *L. rufescens* and var. *macrocarpa*, and represent 18% of all the elements. Although *Juncus papillosus*, *J. Krameri*, *J. decipiens* and *Luzula capitata* were first recorded as species endemic to Japan, they are now known as widely distributed in East Asia, but do not extend to the outside of the latter. *Juncus decipiens* was formerly regarded to be a variety of *Juncus effusus*, and *Luzula capitata* and *L. oligantha* to be varieties of *L. campestris* (or *L. sudetica*), but they are at present considered to be distinct by many taxonomists who are inclined to think that the floras of East Asia and those of the other continents are independently developed since geological ages. *Juncus effusus* and *J. compressus* so far recorded from China are probably, in my opinion, to be respectively reduced to *Juncus decipiens* and *J. compressus* var. *gracillimus* which latter is rather to be considered as independent species limited to East Asia.

5. By the south-western elements are meant those distributed from the south-western parts of Japan to the south-eastern parts of China. They number but 7 (6 species and 1 variety): namely, *Juncus alatus*, *J. diastrophanthus*, *J. modicus*, *J. setchuensis* var. *effusoides*, *Luzula plumosa*, *L. effusa* and *L. chinensis*. They correspond to 12% of all the elements.

The following table shows the number of species and varieties in each different kind of elements and their ratios to the total sum of the elements shown in percentage.

Table V.

Different kinds of elements	Species	Varieties	Elements	Ratios of the number of different element to the total sum of elements
Endemic elements	14	11	25	ca. 39%
Northern and north-western elements	8	5	13	ca. 20%
Common elements	10	1	11	ca. 17%
North-eastern elements	9	1	10	ca. 15%
South-western elements	6	1	7	ca. 11%

It is interesting to notice that the Juncaceous flora of Japan comprises 39% endemic species and varieties which exist comparatively more numerous in the south-western districts than in the north-eastern, although the latter possesses far much more species and varieties than the former, when considered all kinds of elements.

Table VI. showing the distribution of species in different districts within
and without the Empire of Japan.

No. 1. *Junci Poiophylli.*

[illegible]

No. 3. *Junci Genuini*, *Alpini* and *Graminifolii*.

Subgenera	Species	Districts											
		Kuriles	Saghalien	Yezo	Honsyu	Corea	Sikoku	Kyusyu	Ryukyus	Formosa	Bonins	Manchuria	China
<i>Genuini</i>	<i>J. beringensis</i>	+		+	+								
	<i>J. brachyspathus</i>					+						+	
	<i>J. curvatus</i>	+	+	+	+								
	<i>J. decipiens</i>			+	+	+	+	+		+		+	
	var. <i>gracilis</i>	+	+	+	+		+						
	var. <i>glomeratus</i>	+	+	+	+	+							
	<i>J. Fauriei</i>	+	+	+	+			+					
	<i>J. filiformis</i>	+	+									+	
	<i>J. Haenkei</i>	+	+	+		+						+	
	<i>J. setchuensis</i> var. <i>effusoides</i>				+	+		+				+	
	var. <i>compactus</i>					+							
	<i>J. castaneus</i>	+		+		+						+	+
	var. <i>koreanus</i>					+							
<i>Alpini</i>	<i>J. luzuliformis</i> var. <i>Potaninii</i>			+		+						+	
	<i>J. Maximowiczii</i>				+	+							
	<i>J. modicus</i>									+		+	
	<i>J. stygius</i>	+				+							
	<i>J. triglumis</i>	+		+	+	+						+	+
<i>Graminifolii</i>	<i>J. prominens</i>	+		+									+
						+						+	+

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Juncus bombonzanensis SATAKE. ca. $\frac{1}{2}$



Juncus nikkoensis SATAKE. ca. $\frac{1}{2.2}$



Juncus yakeisidakensis SATAKE. ca. $\frac{1}{1.7}$



Luzula taiwaniana SATAKE. ca. $\frac{1}{2.5}$

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